

A method comparison analysis examining the relationship between linguistic tone, melodic tune, and sung performances of children's songs in Chicahuaxtla Triqui: Findings and implications for documentary linguistics and indigenous language communities

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Linguistic tones play an important role in expressing lexical and grammatical meaning in tone languages. A small change in the pitch of a word can result in an entirely different meaning. A logical question for those who document tone languages is whether or not singers preserve linguistic tone when singing and if so, to what degree? I begin by providing an overview of research in documentary linguistics that examines the interrelationship between linguistic tone and melody in tone languages. While the majority of articles have focused on Asian and African languages, there is only one investigation by Pike (1939) that examined the relationship between tone and tune in an unspecified variety of Mixtec, an Otomanguean language. In order to further our understanding of the tone-tune relationship, especially with regard to Otomanguean languages, I use three separate procedures for looking at the interrelationship between tone and tune in spoken, sung, and played performances of two popular children's songs in Chicahuaxtla Triqui. While the first experiment yielded a non-significant relationship between linguistic tone and note transitions in the musical scores, the second and third experiments showed that the pitch traces of the spoken and played performances of the songs both relate to and perhaps influence pitch transitions and pitch transition differentials in the sung performances. The overall finding is that the song melody appears to exert a greater influence on the pitch tracings of the sung performances than does linguistic tone as measured in the spoken performances of the songs. With regard to experimental studies examining tone and tune, this study suggests that a set of well-defined prosodic features, such as overall pitch range, average F_0 , F_0 for individual tones, and the difference between adjacent tones as measured in Hz, need to be considered when comparing tone to melodic tune. Simply correlating the correspondence or directionality of linguistic tones to that of the note transitions in musical scores does not appear to be promising nor sensitive enough to reveal the true interrelationship between tone and tune. This article ends with a discussion of the benefits of documenting songs in tone languages for linguists in addition to the advantages of teaching music to children of indigenous language communities.



1. Introduction¹ Linguistic tones play an important role in expressing both grammatical and lexical meaning in tone languages. A small change in the tone (i.e., pitch or fundamental frequency) of a word can result in an entirely different meaning. A logical question for those who document tone languages is whether or not singers preserve linguistic tone when singing, and if so, to what degree?

The purpose of this article is to examine the interrelationship between linguistic tone and melodic tune by comparing spoken, sung and played performances of two popular children's songs in Chichahuaxtla Triqui.² In this study, three different experiments were carried out in order to determine the correspondence between linguistic tone and melodic tune. In the first experiment, I adopt procedures used by List (1961), Richards (1972), Chan (1987), Agawu (1988), and Ketkaew & Pittayaporn (2014) to compare the direction of movement of note transitions in musical scores to pitch transitions in speech performances of the songs. For this portion of the study, linguistic tone and musical note transitions were examined across successive syllables and were coded as ascending, descending, or level.³ I refer to the methods like those used in the first experiment as directionality comparison studies. In addition to calculating percentages of agreement, as has been done with many previous tone-tune studies, I also carry out a correlational analysis not only to determine the strength of the relationship between linguistic tone and musical note transitions, but also to ascertain the degree to which the findings observed may be due to chance (i.e., *p*-values). In this article, the term "musical notes" is used to refer to the pitch of the sound and not as a measure of relative duration or rhythm. Following McPherson, Ryan, & Hall (2017:9), while questions of time signatures are important rhythmic and metrical aspects of tonal text-setting, they are not the main focus of this article. As per Schellenberg (2009:139), this is not meant to deny the importance of rhythm or duration; however, the division is made only for the simplification of analysis. I do address briefly, however, in §5.3 below, the relationship between positions of met-

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²Recordings for this article can be obtained at: <https://www.ailla.utexas.org/islandora/object/ailla:263102>.

³As I point out in §6.1 below, other researchers have carried out tone-tune directionality comparison studies by coding linguistic and musical note transitions not as ascending, level, or descending but rather as parallel (e.g., if the transition is the same in both sung and spoken performances), opposing, if the transitions between sung and spoken performances go in opposite directions (e.g., one goes up while the other goes down), and non-opposing, if the transition when speaking goes down but remains the same when singing (Schellenberg 2009, 2012a; Kirby, & Ladd 2016). This method of analysis will not be used in the present research.

rical prominence (i.e., beats) in the songs in relation linguistically salient, stressed, or accented syllables in the spoken versions of the song text.

The second and third experiments use fundamental frequency measurements for three separate performance types: spoken, sung, and played performances. I obtained instrumental recordings of the songs in order to accomplish two goals. First, I wanted to determine whether or not Chicahuaxtla Triqui melodies are played in accordance with a Western musical tradition (something we did not know beforehand), and second, to see if the sung performances have an underlying melody that is not adequately represented by the pitches in the instrumental renditions of the songs as has been reported on in other tone-tune studies by Morey (2010; 2014), Lissour & Demolin (2015), Proto (2016), Morton (1976), and Tanese-Ito (1988). (For more information, see §7 below). Using average *F₀* measurements, a correlational analysis is carried out in the second experiment in order to see which variable, average Hz measurements in the spoken or played performances, most related to the pitch tracings in the sung performances of the songs. In the third experiment, pitch transition differentials were calculated by subtracting the average Hz value of the nucleus of one syllable from that of the previous syllable. Pitch transition differentials measure the degree of change in the average pitch values across successive syllables in all three performance types. Positive differentials indicate a rise in the *F₀* whereas negative values indicate a lowering. Pitch transition differentials for all three versions of the songs were submitted to a correlational analysis. Multiple regression analyses were carried out in the second and third experiments in order to determine which of the independent variables best relates to the pitch tracings in sung performances of the songs. The purpose of including three different experiments is to provide preliminary evidence as to the most appropriate method of analysis in tone-tune studies and to determine whether or not these three methods of experimental analysis can be used interchangeably without affecting the outcome or conclusions.

This article ends with a discussion of the benefits of documenting songs in tone languages for linguists in addition to the advantages that teaching music has for children of indigenous language communities.

2. Previous research on tone and tune Studies examining the interrelationship between linguistic tone and melodic tune have yielded seemingly inconsistent and even contradictory results. While a plurality of studies surveyed for this research (approximately 52%) report finding a high degree of tone and tune matching (Mendenhall 1975; Leben 1983; Chan 1987; Wong & Diehl 2002; Wee 2007; Schellenberg 2009; 2011; Morey 2010; 2014; Sollis 2010; Karlsson et al. 2014; Ketkaew & Pittayaporn 2014; Lissour & Demolin 2015; Kirby & Ladd 2016; Proto 2016), others report a low degree of tone-tune correspondence in languages such as Northern Ewe (Agawu 1988), Cantonese (Ho 2006), Kalam Kohistani (Baart 2004), Dagaare (Bodomo & Mora 2000), and in Mandarin (Schellenberg 2012b). Several studies (see e.g., Herzog 1934; List 1961; Richards 1972; Rycroft 1979; Saurman 1999; Gibbon et al. 2011; Connell 2012) report mixed results in which some songs evidence a high correspondence between linguistic tone and melodic tune while other songs in the same

language do not and appear to be genre-dependent. Table 1 below lists previous tone-tune studies reporting high, mixed, and low degrees of tone-tune matching. The language under investigation and publication dates are included as parenthetical information in the table.

Table 1. Studies reporting high, low, and mixed degrees of lexical tone and melodic tune matching.

High degree of tone-tune matching:	Mixed degrees of tone-tune matching:	Low degree of tone-tune matching:
Mendenhall 1975 (Thai)	Herzog 1934 (Navaho)	Pike 1939 (Mixtec)
Leben 1983 (Hausa)	Gambling songs)	Blacking 1967 (Venda children's songs)
Chan 1987 (Cantonese)	List 1961 (Thai)	Agawu 1988 (Northern Ewe)
Wong & Diehl 2002 (Cantonese)	Richards 1972 (Hausa)	Bodomo & Mora 2000 (Dagaare)
Wee, Lian Hee 2007 (Mandarin)	Rycroft 1979 (Southern Africa Music)	Baart 2004 (Kalam Kohistani)
Schellenberg 2009 (Shona)	Saurman 1999 (Thai)	Ho 2006 (Cantonese)
Morey 2010 (Tai Phake)	Gibbon, Ahoua & Kouamé 2011 (Anyi)	Schellenberg 2012b (Mandarin)
Sollis 2010 (Duna)	Connell 2012 (Mambila)	
Schellenberg 2011 (Cantonese)		
Karlsson et al. 2014 (Kammu)		
Morey 2014 (Tai Phake)		
Ketkaew & Pittayaporn 2014 (Thai)		
Lissoir & Demolin 2015 (Tai Dam)		
Kirby & Ladd 2016 (Vietnamese)		
Proto 2016 (Fe'Fe' Bamileke)		

Schellenberg (2009:139) states that there are three possible directions in which pitch values can move in a tone language: up, down, or they may remain the same. Drawing upon Schellenberg's (2009) work on tonal text-setting in Shona, a language with only two tones, high (H) and low (L), Ladd (2013:6) states that the following represents ideal note and tone transitions between sung, played, and spoken performances as illustrated in Table 2 below.

Table 2. Example of the ideal musical sequence in relation to tone transitions in a language with two tones, H and L (based on Ladd 2013 and Schellenberg 2009).

Tone sequence:	Ideal note sequence:
L H	Up
H L	Down
H H	Level
L L	Level

The expectation is that when a tone sequence moves from a L tone to a H tone, there should be a concomitant rise in the musical score as well. Conversely, a HL tone sequence should go down in the musical performance while HH and LL tone sequences should be mapped onto the melody as level note transitions. We will see,

however, that many tone-tune studies surveyed here report mismatches between linguistic tone and melodic tune but for whatever reasons, these mismatches do not appear to influence native speakers' interpretations of the song lyrics.

One of the earliest studies to look at the relationship between linguistic tone and melodic tune was carried out by Herzog (1934) on the Navaho language. Using a corpus of traditional Navaho songs from various popular genres, Herzog found that gambling songs evidence the highest relationship between linguistic tone and melody. Healing songs and songs about natural events, such as flooding and raining, show extremely low correspondences. Herzog (1934:466) concludes that the songs he examined "illustrate a constant conflict and accommodation between musical tendencies and curves traced by speech-tones of the song-text". Although he found that different musical genres yielded divergent degrees of tone-tune correspondence, he did not speculate what might account for this finding.

Other studies lend credence to Herzog's findings and report that musical genres play a significant role in determining how well the melody of a song reflects linguistic tone. For example, in his study of SiSwati and Zulu languages, Rycroft (1979) found that there is a close correspondence between linguistic tone and musical tune with sung poetry and war chants, however, on the other end of the spectrum, tone-tune mismatches occur with modern church hymns, school songs, and popular music.

Tone and tune mismatches were also reported by Saurman (1999) who found that the relationship between speech tone and melodic tune differs in accordance with musical genre. She found that the relationship between tone and tune in classical and traditional Thai songs was about 90% while that figure dropped to between 60% to 70% for contemporary Thai music. In her study, she also looked at Western hymns translated into Thai using the same melody and found a correspondence of about 42%. One of the western hymns titled "He Lives" when translated into Thai resulted in unintended meanings. For example, one key sentence in the song reads "Whenever I need God, he is near", however, the word 'near' (*klay* with a falling tone) is sung as level mid tone which changes the meaning from 'near' to 'far away' thus leading people to interpret this sentence as 'Whenever I need God, he is far away' (Saurman 1999:20).

The song reported by Saurman (1999) to have the lowest correspondence was the Thai National Anthem with a tone-tune correspondence of approximately 32%. Several of Saurman's native speaker consultants said they understood the national anthem in spite of the tone-tune mismatches. Saurman (1999:22) claimed that subjects' ability to understand the song could be attributed to native speakers' "familiarity", "association", and "prior experience" that enable them to associate meaning to the words regardless of the mismatches between linguistic tone and melodic tune.

Other tone-tune studies have been carried out with the Thai language. For example, Mendenhall (1975) looked at the interaction between linguistic tone and musical pitch in twelve songs of the *sēphā* type, either of the *sām chan*, *thao*, or *sōng chan* forms in Thai. The author hypothesized that "syllabic singing" (i.e., words are sung with only one pitch per syllable) have more speech-like features and will correlate more with linguistic tone in comparison to melismatic singing. Melismatic is a musical

term that describes a single syllable that is sung with two or more contiguous notes. Mendenhall looked at the pitch contour of musical notes as well as the pitches of both preceding and following notes. He then calculated percentages of consistencies and inconsistencies between melodic notes and linguistic tones. Mendenhall concludes that linguistic tones and musical notes are correlated at least with regard to certain styles. Based on his findings, he found that syllabically sung words show a higher degree of consistency while melismatically sung words are more inconsistent in relation to linguistic tone. Mendenhall notes that contour tones generally follow the direction of their tone – that is, rising tones are sung as ascending and falling tones as descending. He states, however, that falling tones show more exceptions than do rising tones.

List (1961) looked at the relationship between tone and tune with popular Thai songs, children's musical recitations, and traditional songs. He found that children's recitations and traditional songs evidenced the most correspondence, yielding tone-tune matches of 79%, 90%, and 100% for the three songs he analyzed. The two popular songs showed the least correspondence of approximately 59% to 60%. List's findings suggest that differing song genres yield different degrees of tone-tune correspondence. Furthermore, he found that in rapid singing, rising contours are usually sung as a high tone while falling contours as a low tone without any apparent effect on song interpretation. One of his consultants reported, however, that this is usually true when the contour tone is phonetic and not phonemic. Therefore, one can surmise that it is more important to maintain lexical tone contrasts in singing when conveying meaning is the goal.

Blacking (1967) found that with some genres of Venda music there is a significant relationship between tone and tune especially with songs in which words and conveying meaning are the focus. Blacking argues, however, that linguistic tones may be distorted in order to comply with certain musical styles and genres such as with children's music. In his examination of several children's songs, Blacking (1967:168) found that "speech-tone patterns are sacrificed almost entirely for musical considerations". He adds that the Venda people do not expect songs to sound like ordinary speech and that "they generally understand the meaning of texts, even if the patterns of speech-tone are distorted by the melody" (166). In addition, Blacking reports that with some songs, the melody of the first line tends to correspond more to linguistic tone and that subsequent distortions of the tone in favor of the melody do not result in misunderstandings. He states that "[o]nce the basic melodic pattern of the song is set, influenced partly by linguistic and partly by musical factors, it is probably that the melody and metre then exert some influence on the word-composition of the subsequent lines" (170–171).

While it is tempting to state that there is a connection between musical genre and the degree of correspondence between tone and tune, Schellenberg (2012a:272) cautions that the evidence presented is based on a small amount of data and therefore, generalizability is limited. Schellenberg states, however, that "as the function [of the song] becomes more focused on the music (whatever the function of music may be for these cultures), the primacy of the language seems to decrease and that of music

takes precedence” (272). In other words, Schellenberg believes that there are two types of musical compositions: those that are language focused and those that are musically focused. Language focused musical compositions will contain more speech-like characteristics and will have a higher tone-tune correspondence over songs that are more musically focused. When communicating meaning is more important as it is with language-focused songs, fewer mismatches should occur between linguistic tone and melodic tune.

Gibbon et al. (2011:743–744) propose a linear Conventionality Scale ranging from more ‘stylized’ melodies and timing in music to complex determinants of melody and timing in speech. They hypothesize that “more natural musical genres have fewer stylized and more speech-like features, and that styles with both ceremonial and emotional content, will occupy an intermediate position on the scale”. Table 3 below illustrates where various types of music- and speech-like songs would fall on the Conventionality Scale continuum.

Table 3. The Linear Conventionality Scale continuum based on research by Gibbon et al. (2011:743–744).

Conventional (more music-like):	←—————→	Natural (more speech-like):
Church hymns (Rycroft)	Funeral dirges	Chanting (Rycroft)
Popular music (List; Rycroft)	(Gibbon et al.)	Mnemonic recitations (List)
Opera		Street Vendor Hawking (Chao)
Classical Music (List)		War cries (Rycroft)
Children’s music (Blacking)		Gambling songs (Herzog)

According to the model, Gibbon et al. (2011) state that chanting, war cries, and gambling songs as in Navaho, for example, will have more speech-like characteristics and will have a greater tone-tune correspondence in comparison to more ‘music-like’ compositions, such as translated church hymns, popular songs, and classical music. They argue that songs with emotional content, such as funeral dirges, will fall somewhere in between and will contain both speech-like and music-like characteristics. Gibbon et al.’s findings were mixed regarding the mapping of linguistic tone onto melodies. They found that both song and speech overlap in terms of their prosodic properties (e.g., pitch height, range, and down-step) and conclude that speech-song relations represent a special case of style variation. Gibbon et al. note that the Conventionality Scale is useful in accounting for even small speech-song differences insofar as they found that at the speech end of the scale, pitch changes are more “abrupt” and contour tones are less holistic in comparison to pitch changes in songs that are more music-like (745).

Previous tone-tune correspondence studies may even report contradictory findings when using the same data set. For example, using sung and spoken versions of the “Wákàr Índèfèndà” or “Song of Independence” in Hausa, Richards (1972) found that the degree of agreement between linguistic tone and melodic tune could not be attributed entirely to chance. Although he reports finding many mismatches and

discrepancies throughout the song, Richards (1953) concludes that singers “endeavor where possible to project tonal patterns of the words [when singing]” although it is not always perfectly achieved. Richards found that the beginnings of A lines and AB couplets show notably greater amounts of “parallelism” (Richards’ terminology) than do other portions of the text. In addition, the degree of correspondence neither increases nor decreases throughout the fifty lines he analyzed of the song. Richards concluded that the “song has a distinct melodic life of its own in which criteria of musical development operate independently, in part at least, of any constraints deriving from the pattern of text-tones” (1953). Richards does not go into any great detail explaining what might be motivating this setting, however, his finding that the sung versions of a song text “have a distinct melodic life of their own” supports my own findings in this research in addition to those of Morey (2010; 2014), Lissor & Demolin (2015), Proto (2016), Morton (1976), and Tanese-Ito (1988) that I outline more clearly in §7 below.

Richard’s analysis was later disputed by Leben (1983) who argued that the former did not take into consideration tone downdrift (i.e., the tendency for a high tone to lower after a low tone) in a spoken sentence or tone sandhi when calculating the relationship between linguistic tone and melodic tune. According to Leben, when other linguistic factors are taken into consideration, the correspondence between the sung and spoken versions of the “Song of Independence” in Hausa is much greater than what was previously reported by Richards.

Another example where different methods of analysis may yield inconsistent results can be seen with Pike’s (1939) summary abstract in which he reported on the correspondence between linguistic tone and tune in a Mixtec⁴ song titled, “The Flea”. Although Pike does not indicate where the recording of the song was made nor which Mixtec language is the focus of his study, he states that this particular variety of Mixtec (Pike 1939:128) has three phonemic tone registers consisting of high, mid, and low. Based on a syllable-by-syllable comparison of the sung and spoken versions of “The Flea”, Pike concludes that the melody evidences various sub-patterns that are not caused nor influenced by linguistic tone. In addition, he states that Spanish loan words (e.g., *ámigó* ‘friend’, *korrédóòr* ‘hallway’, *balasó* ‘bullet’, *Kolimá* ‘Colima’, *mûl* ‘one thousand’, and *Rinkóòn* ‘corner’) appear to affect the tonal melody more than native Mixtec words. Pike does not speculate why this may be or precisely how Spanish words influence Mixtec tones when singing or speaking. Pike’s abstract is purely qualitative and does not provide concrete data (i.e., statistics) regarding the degree of tone-tune correspondence between spoken and sung versions of “The Flea”.

Pike (1939:130–133) provides transcripts of both versions in which he marks linguistic tone and melodic tune using a series of diacritics. For example, by marking high [ˊ], mid [-], and low tones [ˋ], he is able to compare both spoken and sung versions. Instances in which the spoken words differed from the melody were marked

⁴Mixtec belongs to the Otomanguean language family and is related to Triqui and Cuicatec. El Instituto Nacional de Lenguas Indígenas (INALI 2012) estimates that there are approximately 476,472 people who speak some variety of a Mixtec language in the State of Oaxaca, Mexico. INALI (<http://site.inali.gob.mx/pdf/libro.pdf>). Ethnologue (Lewis et al. 2016) lists a total of 51 Mixtec languages, many of which are not mutually intelligible.

with a broken line [- - - - -] and were not analyzed by Pike. Figure 1 below illustrates the method used by Pike in order to compare melodic tune to spoken tone. In the illustration below, the first set of lines (1a) depicts the tones used when singing while the second line represents spoken tones of the same words. Line 3 is a free translation to English. The second set of lines (1b) below was deemed unusable by Pike given the discrepancies between both versions and was not included in his analysis. Pike noted that the differences between both the sung and spoken versions of the song were too great to conclude that the melody is influenced by linguistic tone.

Figure 1. Sample coding system used by Pike (1939) and statistical recoding of his data.

1a		
và-i-rí kátá-rí nú ámigó-rì:	\- ' ' ' '-\:	
và-i-rì kàtá-rì nù ámigó-rì	\- -\ \ '-\	
<i>I come to sing to my friend</i>		
Sample Recoding:	Sung version:	123 333 3 3231
	Spoken:	121 221 1 3231
1b		
ni ʔdÁʔÁ ñúú ní kájinì:	- " " ' '-\:	
ni(i) kà jìnì tàkà ñúú	-----	
<i>every town knew</i>		
Sample Recoding:	Sung version:	2 33 33 3 321
	Spoken:	Incomparable

The present author reanalyzed Pike's data to see if the correspondence between tone and tune is statistically significant in "The Flea". In order to carry out the analysis, each syllable was quantified as per Pike's original analysis. High register tones were coded as '3', mid-register tones as '2', and low register tones as '1'. Instances in which the spoken version of the song were deemed incomparable as per Pike were excluded from this analysis. Analysis using the Statistical Package for Social Sciences (henceforth SPSS) showed that lexical tone *is* significantly correlated with melodic tune in "The Flea", however, the correlation is relatively low ($r = .21$, $p < .05$, $n = 110$). It appears then that spoken tone accounts for a relatively small portion of note transitions in the melody of "The Flea". Chan (1987) argues that if songwriters take lexical tone into consideration when composing, there should be a relatively high correlation between linguistic tone and melodic tune. Given the weak correlation between the sung and spoken versions of "The Flea", it is quite possible that the tone-tune mismatches could result in misinterpretations, however, more follow-up research would be needed in order to support such a claim. As far as the present researcher is aware, Pike's (1939) research is important because it is the first and only study examining the interrelationship between tone and tune in an Otomanguean language. This is clearly an area where additional research is warranted.

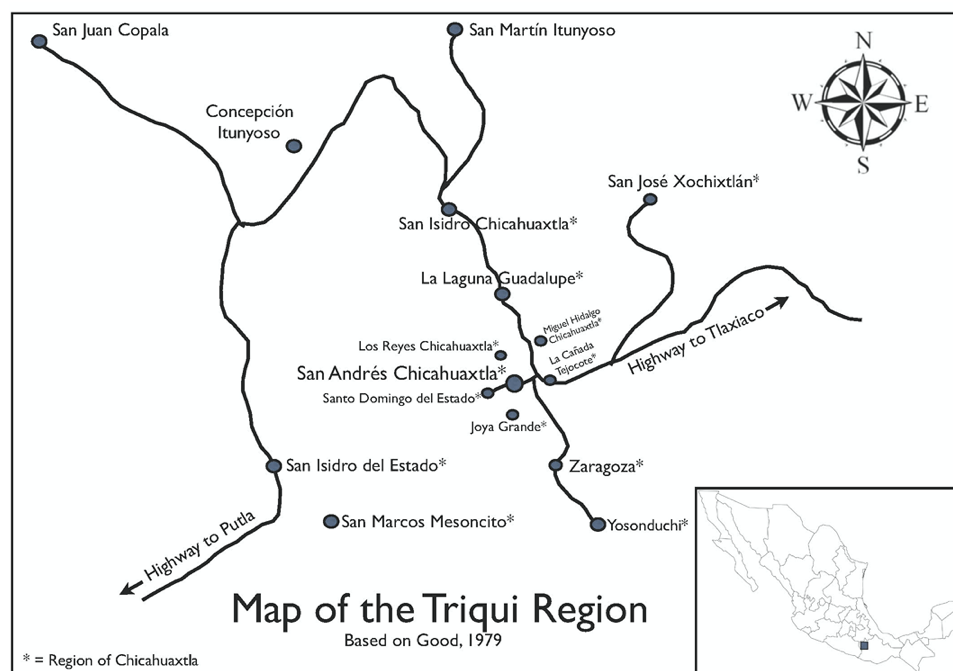
The following sections provide the reader with basic information regarding the Chicahuaxtla Triqui people and their language. The details presented below are more than sufficient for the reader to follow the current analyses.

3. The Chicahuaxtla Triqui people and their language

3.1 The Triqui region Chicahuaxtla Triqui is an Otomanguean language spoken in San Andrés Chicahuaxtla and in several other neighboring communities in the state of Oaxaca, Mexico. There are two other Triqui languages that are spoken in close proximity to San Andrés Chicahuaxtla. One is spoken in San Martín Itunyoso (Dicano 2010; 2012; 2016) and the other in San Juan Copala (Hollenbach 1977; 1984; 2008; 2016). According to the most recent estimates (Ethnologue, Lewis et al. 2016), Copala Triqui has approximately 25,000 speakers, followed by Chicahuaxtla Triqui with 4,060 speakers, and Itunyoso Triqui with approximately 2,000 speakers.

The Triqui people live in the northwestern region of the State of Oaxaca, Mexico. Figure 2 is a map of the Triqui region listing the major areas where the Triqui languages are spoken.

Figure 2. Map of the Triqui region (Based on Good 1979)



3.2 Chicahuaxtla Triqui Consonants Chicahuaxtla Triqui has four voiceless plosives /p t k k^w/, four voiced plosives /b d g g^w/, three affricates /ts tʃ tʂ/, five sibilants /s z ʃ ʒ ʂ/, two laryngeals /h ʔ/, two prenasalized plosives /nd ng/, and ten lenis-fortis

sonorant consonants /m m: n n: l l: j j: w w:/, in addition to voiceless and voiced lenis-fortis consonants pairs /p t k s f/ and /b d g z ʒ/. In Chicahuaxtla Triqui, lenis-fortis phonemic contrasts may consist of contrasts in consonant length, voicing, or strength of articulation. Finally, the voiced palatal approximant /j/ has an allophone [j̃] that nasalizes before a nasal vowel, for example, [j̃ãʔã^{2h}ã] ‘God’, [j̃ã:³²] ‘salt’, or [j̃ũ:⁴] ‘earthquake’.

3.3 Chicahuaxtla Triqui Vowels Chicahuaxtla Triqui has seven oral vowels [i e ə a o u] and four nasal vowels [ĩ ã ũ ã̃]. [ẽ õ] occur in morphologically-derived forms in verbs, possessed nouns, predicate adjectives, and prepositions (Hernández Mendoza 2013; Elliott et al. 2016; Elliott 2017), for example, [duʔ⁴we^{2h}ẽ³] ‘he/she sells’ or [si:³ na²tõ²²õ³] ‘his/her banana’. The mid central vowel /ə/ rarely occurs but can be found in words such as [ə:⁴³] ‘what?’, as an interjection, [jə³h] ‘stone’, and [əʔə:³² ʒioʔ⁴] ‘hiccough’. Both [ə] and [u] have merged with [e] and [a] in some neighboring dialects. This is especially true with younger speakers of the language in San Andrés Chicahuaxtla. Contiguous vowels are always pronounced in hiatus, except for some Spanish loanwords as described by Elliott (2017). Word-final long vowels are phonetic and do not contrast with short vowels. Finally, word-final syllables in Chicahuaxtla Triqui may end in a modal, nasal, aspirated, or glottalized vowel, for example, -/V:/, -/Ṽ:/, -/Vh/, -/Vʔ/, and -/V^{2h}V/, as illustrated in Table 4 below.

Table 4. Sample word-final rimes illustrated with minimal pairs in Chicahuaxtla Triqui.

Rime:	Word:	Transcription:	Gloss:
/V:/	nne	[n:e: ³]	‘plow’
/Vh/	nej	[ne ³ h]	‘PL’ (plural marker)
/Vʔ/	ne’	[ne ⁴ ʔ]	‘we.INCL’
/V ² V/	ne’e	[ne ³² e]	‘child’
/V ^h V/	nnej e ⁵	[n:e ^{3h} e]	‘dream, sleep’

3.4 Chicahuaxtla Triqui Tones Tone inventories for the Triqui languages are quite diverse and complex. DiCanio (2010:234) reports that Itunyoso Triqui has nine tones: four level tones, three falling tones, and two rising tones while Hollenbach (1984) identifies 8 phonemically contrastive tones in Copala Triqui. Good (1979) documents at least 10 tones in Chicahuaxtla Triqui, however, Longacre (1952) says there may be 19 or more. In a recent study, Elliott (2017) documents a total of 15 tone contrasts with a possibility of 25 different word-final tone and rime sequences. This finding makes Chicahuaxtla Triqui rank among the most complex tone languages in

⁵Words containing the laryngeal /h/ and followed by a vowel are now written by some teachers with a space between the laryngeal and the vowel, whereas at one time, they were written as one word. For example, *nneje* [n:e^{3h}e] ‘dream’ is now written as *nnej e*. The consultants reported “writing the word without the space would result in unnatural pronunciation”. For more information on the developing orthographic system in Chicahuaxtla Triqui, see Elliott et al. (2012) and Elliott (2016; 2017).

the world. In this paper, tones are marked from 1 to 5, where 1 is the lowest tone and 5 is the highest.

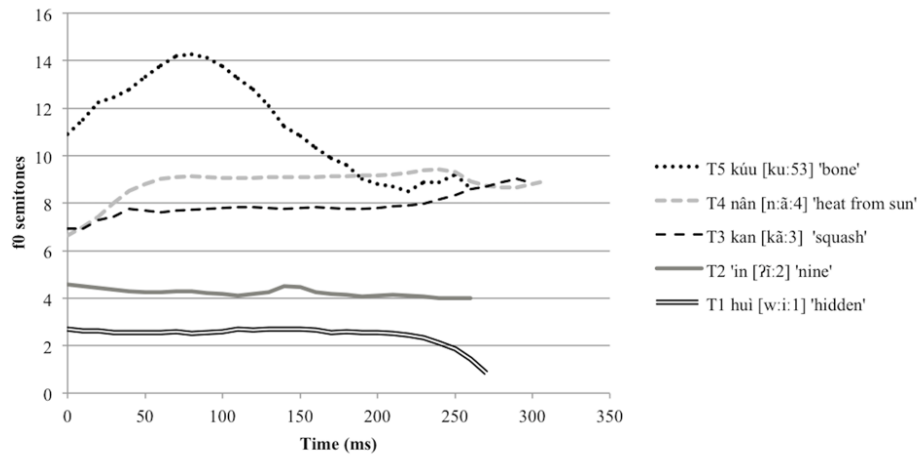
Chicahuaxtla Triqui has five tones: an extra high tone /⁵/ that is always realized as a glide (e.g., [53] [35] and [353]), a high tone /⁴/, a mid-tone /³/, a low tone /²/, and an extra low tone /¹/. Words may end in one, two, or three tone sequences. In Chicahuaxtla Triqui the default tone is /³/ and is usually not marked in nonfinal syllables unless it forms phonemically contrastive minimal pairs, for example, [ʒi⁴lu:³] ‘knife’, [ʒi³lu:³] ‘cat’, and [ʒi³lu:⁵³] ‘worm’. Contour tones only occur in word-final syllables, for example, [goʔo:³² si³h] ‘he drinks’, [n:i:³¹³] ‘last night’, or [a³tʃi³²h si³h] ‘he grows’. Lexical items ending in three tone sequences are limited to monosyllabic or disyllabic words ending in a vowel. In Chicahuaxtla Triqui, words that end in a glottal stop [ʔ] or [h] show fewer tone combinations than do lexical items that end in a vowel. Although tone and rime interact in Chicahuaxtla Triqui, they are not the same. Elliott (2017:10) states that at the phonological level, “the inventory of possible tones is constrained by whether and where the tone-bearing syllable involves laryngeals. There are fewer tone possibilities with words ending in a /ʔ/ or /h/ than there are with words ending in a vowel”. As with all tone languages, small changes in tone in Chicahuaxtla Triqui give rise to completely different words, each with its own meaning depending on the pitch in final syllables. For example, Table 5 lists sample minimal pairs in Chicahuaxtla Triqui.

Table 5. Sample minimal pair final tone contrasts in Chicahuaxtla Triqui.

Words:		
(1)	[n:e: ¹]	‘naked’
(2)	[n:e: ²]	‘conceited’
(3)	[n:e: ³]	‘plow’
(4)	[n:e: ²³]	‘he’s seated’
(5)	[n:e: ³⁵]	‘I’m seated’
(6)	[n:e: ³²³]	‘water’
(7)	[n:e: ³¹³]	‘meat’

The toneplot in Figure 3 below was provided by Elliott, Sandoval Cruz, & Santiago Rojas (2012). The pitch trajectories (F₀) depicting Chicahuaxtla Triqui tones 5 through 1 were extracted using PRAAT and plotted in Microsoft Excel. Based on the differences in semitones (with 0 set at 100 Hz), Elliott, Sandoval Cruz, & Santiago Rojas (2012:218) show that the differences in semitones between tone /¹/ and tone /²/ (i.e., low tones) and tone /³/ and tone /⁴/ (i.e., mid-tones) are minimal and thus has prompted some village leaders and teachers to propose using a three-tone orthographic system marking only HI (´), MID (¨), and LOW (`) tones rather than marking all five tones. Tone /⁵/ (i.e., extra high tone always realized as a glide) averages approximately 5 semitones higher at its peak in relation to /⁴/ in the examples given in the toneplot below.

Given the very complex nature of the Chicahuaxtla Triqui tonal system, very few studies have examined phonemically contrastive tone in Triqui beyond the word level.

Figure 3. Sample tone trajectories in Chicahuaxtla Triqui. (Elliott 2017)

When words spoken in isolation end with two- or three-tone segments, the final tone is eliminated at the sentence, phrasal, or utterance levels or when used in compound words. This is a common feature in Chicahuaxtla Triqui and has also been reported in the other Triqui variants⁶ (see DiCanio 2008; Elliott et al. 2012). The following tokens from Elliott, Sandoval Cruz, & Santiago Rojas (2012) and Hernández Mendoza (2016) in Table 6 below illustrate word-final tone reduction in Chicahuaxtla Triqui:

Table 6. Sample tone reduction of two- and three-tone sequences in Chicahuaxtla Triqui from Elliott, Sandoval Cruz, & Santiago Rojas (2012) and Hernández Mendoza (2016).

Isolated word:	Sentence:
(1) <i>nato</i> [nato: ²³] 'plátano' 'banana/plantain' (Elliott et al. 2012)	<i>Tāj nato maree rihaan mēsa.</i> [ta ¹ h nato: ² mare: ³¹ riã: ³² me ⁴ sa: ³] On.top banana green face table 'There are green bananas on the table.'
(2) <i>to</i> [to: ³²³] 'metate' 'grinding stone' (Hernández Mendoza 2016)	<i>Too nakàa huin nan</i> [to: ³² naka: ¹³ wĩ: ³ nã: ³] grinding stone new is this 'This grinding stone is new.'

⁶The reduction of word-final tones beyond the word level has led some researchers (Edmondson et al. 2012; Hernández Mendoza 2016) to posit the existence of a floating tone in Chicahuaxtla Triqui.

4. Chicahuaxtla Triqui Music, Songs and Poetry Researchers know very little to nothing about music, songs, or poetry in Chicahuaxtla Triqui and other Otomanguean languages. No articles have been written on the topic and no references to Chicahuaxtla Triqui music or poetry can be found in the research literature. While carrying out this research I contacted some of the most renowned researchers of the Triqui languages with over 110 years of combined research experience. All of us have, in one way or another, reached the same conclusion that the Triqui cultures do not have poetry; they have little in the way of music and they do not have the same concept of rhyme, rhythm, or meter as Western and European cultures do. Christian DiCanio (SUNY Buffalo, personal communication, April 2019) indicated that, like Chicahuaxtla Triqui, Itunyoso Triqui has no poetry. When DiCanio explained the concept of rhyming to his consultants and when he tried to get them to give him words that rhymed, his attempts were futile. DiCanio reported that “[they] looked at him as if he had two heads”. Likewise, Aaron Broadwell from the University of Florida (personal communication, April 2019) noted that there “is no poetry in Copala Triqui” and that he has never come across anything that even remotely resembled poetic, lyrical, or rhyming structure.

Probably the most interesting account of rhyme, poetry, and song is that of Barbara Hollenbach (personal communication, April 2019) who is a retired linguist from the Mexico Branch of the Summer Institute of Linguistics and the most well-known and respected researcher of Copala Triqui. Hollenbach reported that she and her husband never found any clear examples of poetry or vocal music in their study of the language from the 60’s to the early 70’s. While they lived in the village, Dr. Hollenbach and her husband tried to get the Triqui people to translate Christian hymns and songs into Copala Triqui or to write new ones. Hollenbach states, “[a]s for musical or poetic rhythm, speakers of Trique do not seem to perceive, nor adapt their speech to poetic meter. When they clap, they don’t clap to the beat”. With specific regard to linguistic tone and musical pitch, Hollenbach stated that “speakers seem willing to override linguistic tone in favor of musical tune”. Hollenbach noted that the only time her consultants worried about linguistic tone in a song was when the pitch of a word made the speakers think of another meaning, either a tone pair, or a similar word with different laryngeals. If there was no conflict with other similar words, disregarding linguistic tone in favor of the music was acceptable to native speakers of the language.

Fidel Hernández (UNAM PhD in Linguistics on Triqui, native speaker of the language and native of San Andrés Chicahuaxtla, personal communication, April 2019) confirmed that there are no Triqui poets and that the only poem he has ever seen in a Triqui language is the one he wrote. He said that when he wrote it, he focused more on the ideas as opposed to rhythm, meter, rhyming, feet, or syllabification. He added, however, that he does not consider himself to be a poet. These professional accounts are not meant say that there is absolutely no verbal or musical art in traditional Triqui languages, but as Hollenbach states, “they do not have the fixed form that is part of poetry or songs as in the European tradition”. She believes this is due to the fact that the language is oral, rather than written.

Hilaria Cruz (2014; 2017) discusses the topic of poetic and lyrical structure in her dissertation research on San Juan Quiahije Chatino, an Otomanguan language spoken in San Juan Quiahije in the State of Oaxaca. According to Cruz (2017:145), San Juan Quiahije Chatino and most Mesoamerican languages use “repetition, semantic parallelism and *difrasismo*⁷ as overriding poetic tropes while traditional poets in Spanish or English have preferred to use rhyme and meter as the basis for poetic composition”. Cruz says that these features are “conventions that function as a primary organizing principle of verbal art in much the same way that meter provides an organizing framework for traditional poetries of much of Europe and Asia” (510). I believe the same can be said with regard to the lyrical structure of the Chicahuaxtla Triqui songs that exist. According to Cruz (2014), these differences pose a great challenge to researchers when trying to decipher an underlying poetic or lyrical structure in accordance with a Western or European tradition. Drawing upon Cruz’ (2014) research, a more productive avenue of investigation would be along these lines (i.e., repetition, semantic parallelism, and *difrasismo*) as opposed to trying to impose an alien system of meter and verse on these languages.

I feel differently with regard to musical composition in Chicahuaxtla Triqui. Having spent a portion of two faculty development leaves documenting the language, I became aware that children in the elementary school in San Miguel Hidalgo Chicahuaxtla sang songs in Triqui but at that time I had no knowledge of their musical system. Therefore, for this study, I wanted to determine whether the Chicahuaxtla Triqui people make use of a Western notation system or not. In other words, does their musical system differ from that of Western music, and if so, in what ways? To answer this question, I asked the music teacher to play the songs either on the guitar or the violin. When I saw him tune his guitar and violin using a clip-on chromatic tuner the way I do and using the same musical notation system that I am familiar with, I was convinced that the instrumental renditions, melody and by extension musical scores were of the Western musical tradition.

5. Methods and materials

5.1 Subject The language consultant is a 58-year-old native of San Andrés Chicahuaxtla who speaks Spanish and Chicahuaxtla Triqui fluently. The consultant is a Professor of Indigenous Bilingual Education and lead teacher at the bilingual elementary school in Miguel Hidalgo Chicahuaxtla. He has over 40 years of teaching experience in both Chicahuaxtla Triqui and Spanish. He teaches the school children to play musical instruments and to sing in both Spanish and Chicahuaxtla Triqui.

5.2 The recordings The songs were recorded in the village of Miguel Hidalgo Chicahuaxtla and in San Andrés Chicahuaxtla during the summers of 2017 and 2018.

⁷*Difrasismo* is a term used to describe a grammatical construction in many Mesoamerican languages in which two words are grouped together to form a single metaphorical unit.

Miguel Hidalgo Chicahuaxtla is located in close proximity, approximately 1 to 2 kilometers, to San Andrés Chicahuaxtla, the principle village where Chicahuaxtla Triqui is spoken. There are no known notable dialectal differences between the variety of Triqui spoken in San Andrés Chicahuaxtla and that of Miguel Hidalgo Chicahuaxtla.

For this study, the subject was recorded at least three times singing each of the songs. Based on the recordings, the lyrics of the songs were then written out and subsequently recorded three times as a spoken text (i.e., speech performances). Finally, the songs were played *pizzicato* either on the guitar or the violin and were also recorded three times.⁸ All recordings were made with Audacity 2.1.3 using a Zoom H4n portable digital recorder connected to a MacBook Pro computer at a sampling rate of 44.1 KHz and a quantization of 16 bits – CD quality.

Data were collected from other consultants as well and will be reported on at a later date. As I was interviewing consultants and recording their singing and spoken performances, I noticed that some speakers switched the lines around quite freely when singing and reciting the songs but all used the same or similar tune. There were some consultants who couldn't seem to sing or recite the same version twice (as well as others who had a difficult time carrying a tune). This made it difficult finding speakers who sang the same versions of the songs. The consultants who sang and recited the same versions are those who are affiliated with the elementary school where the songs are practiced daily and are performed by the children in public. When I asked the music teacher about switching the lines around, he said that the order of the lines in the song doesn't matter, unless, of course, the songs are being sung chorally as the children do. He (Sandoval Cruz, personal communication) noted that several versions of the songs exist – “existen muchas versiones de estas canciones, tantas como cantores que las interpretan”.⁹

Aside from wanting to determine whether or not these songs reflect a Western musical tradition, I also asked about musical genre. In some cultures, including our own, there are musical genres that are not meant to be lexically meaningful. For example, scat improvisations by Ella Fitzgerald, Buddhist monks chanting on a single syllable ('ohm'), the Monkey Chant from Indonesia (although this is more a rhythmic chant and not music per se), and finally, Tuvan throat singers. In addition, ambiguity and multiplicity of meanings may be a highly regarded trait in songs.¹⁰ My consultant indicated that these songs are meant to be understood and that they are mostly sung with musical accompaniment at family and village gatherings, birthday parties,

⁸Standard guitar and violin tunings were used for both songs in this experiment. Both instruments were tuned using the Genuine Fender FT-004 Clip-on Chromatic Tuner. The chromatic tuner has a large LCD display with an easy-to-read needle that shows when the string is out of tune and changes to bright green when in tune. Guitar strings one (1) through six (6) were tuned as follows: (1) E at a frequency of 329 Hz, (2) B at 246 Hz, (3) G at 196 Hz, (4) D at 146 Hz, (5) A at 110 Hz, and finally (6) E at 82 Hz. The scientific pitch from lowest to highest on the guitar is: E2, A2, D3, G3, B3, and E4. The four strings on the violin were tuned in fifths in accordance with standing tuning practices. Violin strings one (1) through (4) were tuned as follows: (1) G at a frequency of 196 Hz, (2) D at 293.66 Hz, (3) A at 440.00 Hz, and finally, (4) E at 659.26 Hz. The scientific pitch from lowest to highest for the violin is: G3, D4, A4, and E5.

⁹“[T]here are many versions of these songs, as many as the singers who interpret them.”

¹⁰I am grateful to an external reviewer for pointing this out.

celebrations, in addition to graduations and other ceremonies held at the elementary school.

5.3 The songs Two children's songs were chosen for this study. The songs were selected because they are taught to all elementary school children in Miguel Hidalgo Chicahuaxtla, are considered valuable for their cultural content, and they are well known throughout the village. The lead teacher at the elementary school indicated that the songs belong in the public domain and that the author is unknown (Sandoval Cruz, personal communication, 2018).

During the recording session, the consultant wrote out all the notes to the songs as shown in the sample in Figure 4 below. Instead of referring to notes as letters of the alphabet, the consultant used typical Spanish names for notes: Do, Re, Mi, Fa, So, La, and Si which correspond to C, D, E, F, G, A, and B notes and the terms *sostenido* and *bemol* for sharp and flat respectively.

Using the *a capella* and *pizzicato* performances played on the violin or guitar, in addition to the teacher-made sheet music described above, a graduate student at the University of Texas at Arlington created the musical scores of the songs (see Appendix A). He also compared the *a capella* performances and the teacher-made music notations with the instrumental recordings to make sure there were no discrepancies among the three different versions. The student is pursuing a Masters of Music in Jazz Composition and currently teaches university courses for the Music Industry Studies department. He holds an Associate of Arts and Sciences (A.A.S.) degree in Songwriting and a Bachelor of Music degree in Jazz Studies.

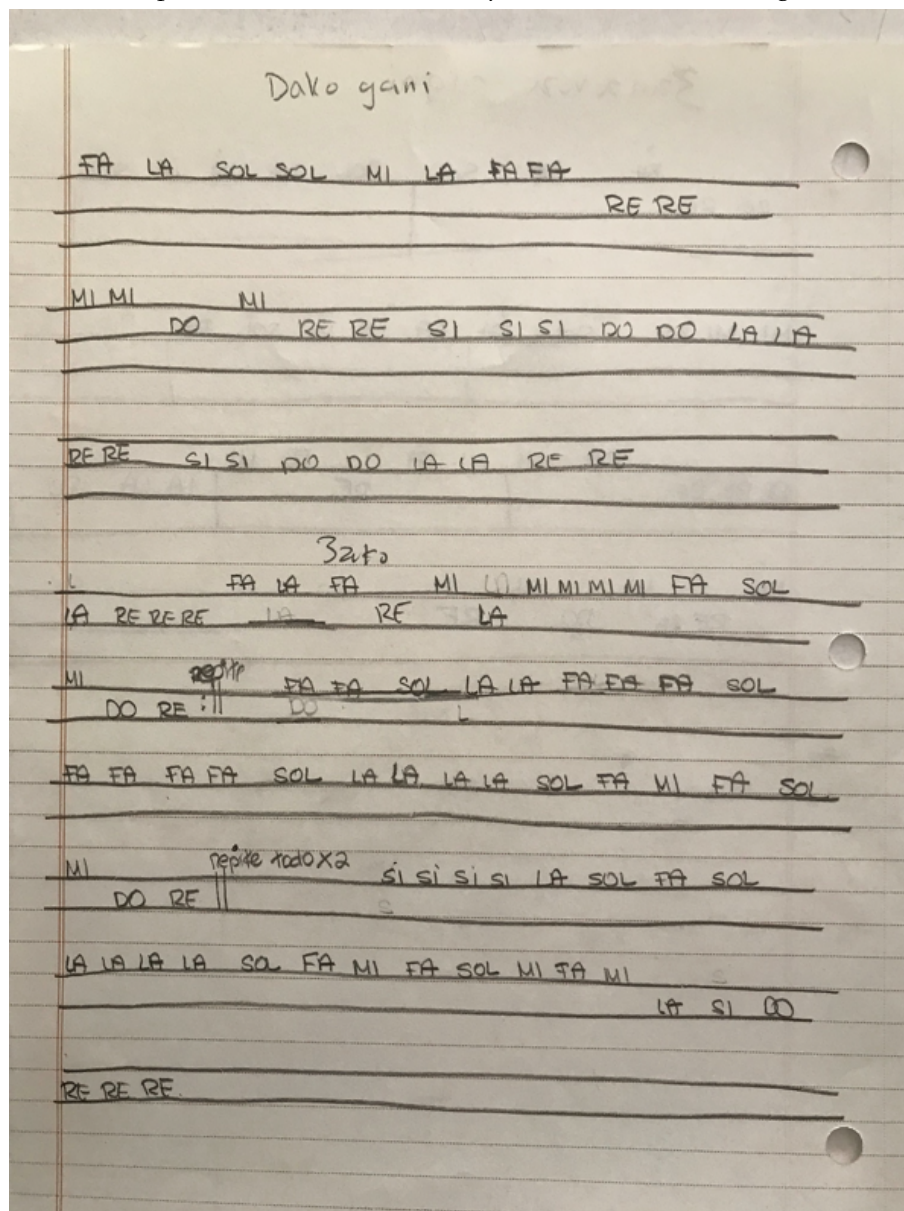
The first song relates a Triqui legend called, “Si-chra' hian'anj an kīj i” [si:³² t̪sa^{3?} ʃã^{3?}ã²hã ku^{3h}u] ‘The Song of the Sacred Goddess of the Mountain’, or more commonly referred to by the Chicahuaxtla Triqui people as “Los dioses sucios” ‘The Dirty Gods’, or by the first line “Dako nganîj” ‘foot with a shoe’. According to the legend, the sacred goddess is an evil entity who lives in the forests high in the mountains right outside of the village. The legend states that when the eerie mist comes down the mountain and blankets the town, the goddess sneaks into the village at night going from house to house in order to eavesdrop so she can learn the Triqui language and to find out the location where the man of the house will be working the following day. Her intention is to appear to him while he is working alone in the fields or in the mountains. According to the legend, the goddess is ugly on the inside and out, but magically transforms herself into a beautiful young woman with long flowing blond hair who is irresistible to any man who sees her. Once she entices him and gets him to fall in love with her, she deceives him by taking his money, his land, and all of his possessions, ultimately destroying the family unit.

Although the song does not recount specific details of the legend itself, it describes the dirty gods’ appearance.¹¹ They have dirty faces with blonde disheveled hair. They

¹¹“Pueden tomar la forma de una persona y tratar de engañarnos; a veces llegan hasta nuestras casas y se llevan a nuestros hijos y los pervierten, hacen que pierdan el respeto por nosotros y por todo lo nuestro. Solamente podemos reconocerlos cuando les damos a comer chile y no saben cómo comerlo o por su manera de vestir, usan sacos y corbatas, usan zapatos o visten de manera diferente a nosotros, usan zapatos y sus pies son como de guajolote.” (Sandoval & Sandoval, as quoted in Fernández et al. 1998:23).

wear dirty and worn out clothes, shoes, and socks. The song describes their boots as a turkey's foot and as big as the *madroño* 'madrinus' tree which the Chicahuaxtla Triqui consultants interpret as the boots worn by the Spanish conquistadors during the 16th century. Sandoval & Sandoval (Fernández et al. 1998:23) say that their ancestors wrote this song so that all would know about the dirty gods. They caution, however, that singing the song is forbidden because doing so may entice the dirty gods to appear.

Figure 4. Sample sheet music written out by the music teacher during field work.



“Si-chra' hian' anj an kij i” is in 4/4 meter and uses the same rhythm for each phrase of the song. The interesting thing about the melody is that it is not in G major, but G Lydian (the 4th mode of the D major scale). The Lydian mode is like the typical major scale, but with a raised 4th scale degree (C# instead of C, or Fi instead of Fa). The Lydian mode sounds a lot brighter than the major scale, and since the melody ends on the fifth scale degree the tune sounds unresolved at the end. The melody uses a sequence of leaping up and stepping down, almost like a vocal exercise.

“Si-chra' hian' anj an kij i” has sixteen lines. The lines are repeated a total of four times in the sung performance. While the majority of lines have four syllables, the last two lines, as illustrated in Figure 5 below, contain five. In the musical score, each line ends with a quaver rest, which brings the total number of beats per line to four.

Figure 5. Musical beats in “Si-chra' hian' anj an kij i”

1	2	3	4	
ḍa-ko: ³²	ḡga-nu ^{4h}		ʔ	‘Foot with a shoe’
5	6	7	8	
ḍa-ko: ³²	lu-pi: ³		ʔ	‘Foot like a turkey’
9	10	11	12	
ḍa-ko: ³²	me-ḍi-a: ³²		ʔ	‘Foot with a sock’
13	14	15	16	
ḍa-ko: ³²	ṡṡū: ³	na-kũ: ³	ʔ	‘Foot like a madroño tree’

Final syllables in Chicahuaxtla Triqui are accentually prominent (i.e., stressed or accented) and carry a heavy tone load. Although tone and accent (i.e., stress) interact in Triqui, they are not the same. DiCanio (2010) notes that word-final stress is phonetically realized via duration and phonologically by distributional asymmetries. In his study of interrelationship between speech and sung melodies, Wee (2007) found that Mandarin Chinese emphasizes positions of metrical prominence and proposes that syllables on the most prominent beats of a song will also be linguistically salient syllables, and that the melodies will match at those points. In their article on tonal text-setting, Dell & Halle (2009:4) state that “[i]n languages in which certain syllables are more stressed than others, there is a preference for songs to associate stressed syllables with strong metrical positions”. They call this “stress-to-beat matching”.¹² This is not the case with the Chicahuaxtla Triqui songs analyzed here. Stressed or accented syllables in the spoken performances of the songs do not always occur with

¹²Dell & Halle (2009:5) argue that stress-to-beat matching may differ depending upon the language. For example, “stress-to-beat matching is more strict in English, where certain stress/beat mismatches are prohibited in all environments” whereas in French “the preference of stressed syllables for strong metrical positions is only a statistical tendency” (Dell & Halle 2009:5). In fact, mismatches between stress and beat in English will make songs sound ill-formed to native English speakers.

the beats in the sung version. In other words, “text-to-beat matching” is not realized (Dell & Halle 2009). In this song, there are a total of 58 syllables – 30 of which are stressed while 28 are unstressed. Of the thirty stressed syllables, only 17 (approximately 56%) occur with the beat while the remaining 44% fall on off-beats. Of the 28 unstressed syllables, approximately 87% (n=24) fall on the beat while the remaining 15% occur on off-beats.

The finding that musical beats do not always coincide with linguistically stressed or accented syllables in Triqui is similar to Burling’s (1966:1429), who in her discussion of the metrics of children’s verses in Chinese, found that, “beats have nothing to do with tone.” Contrary to Wee (2007), Burling examined Chinese children’s verses thinking that “tone may act like English stress in marking out rhythm, but it does not” (Burling 1966:1429). Burling reported that tones “may appear at any position, whether or not that position has a beat”. Based on the analysis of the songs included in this research, the same can be said for these Chicahuaxtla Triqui songs as well.

Drawing upon research by Cruz (2014), the lyrics of the songs documented here can be analyzed in terms of repetition, semantic parallelism, and *difrasismos*, a stylistic device commonly used in verbal art of indigenous languages of Mesoamerica. *Difrasismos* are a particular type of grammatical, semantic, and stylistic construction in which two words or expressions appear together in a sentence in order to construct a new meaning that is independent of their previous meanings when used separately. The first eight lines of the first song are built around a fixed frame made out of the word **Dako** _____, followed by a noun, creating a series of *difrasismos*, for example, *dako nganiĵ* [ḁako:³² ŋganu⁴h] ‘foot shoe’, *dako lupi* [ḁako:³² lupi:³] ‘foot turkey’, or *dako media* [ḁako:³² me⁴dia:³²] ‘foot sock’. The second set of eight lines also consists of *difrasismos* but the majority are no longer fixed around the phrase *dako* [ḁako:³²] ‘foot’ but rather another body part or personal belonging, for example: [si:³² gā³²? re?e:¹³] ‘POSS_clothes dirty’, [awi:³ wi?i:³] ‘hair blonde’, and [riā:³² laḁu?ũ:⁴] ‘face dirt’. One noun is subsequently replaced by another until the listener is provided with a complete description of the ‘dirty gods’ or the Spanish conquistadors’ appearance.

The second song in this research is titled ‘*Yanà hua ri’ni*’ [zana:¹ wa:³² ri⁴?nu:³] ‘The woman has her huipil’. The huipil is a traditional garment worn by indigenous women throughout Mexico and other regions of Central America. In San Andrés Chicahuaxtla, the huipil is a loose-fitting garment that goes from the neck down to the ankles. For the Triqui women, the huipil is a symbol of her identity. Each huipil has an individual story to tell – the woven brocades symbolically represent the cosmovision, cultural myths, traditions, and the daily experiences of the women within their community (Downs-Sánchez 2013). One of my female Triqui consultants who is a backstrap weaver added that the huipil represents the cyclical nature of life. It begins at the neckline that is woven in such a way as to represent the sun, which symbolizes the source of life, and its rays are represented by the colorful hanging ribbons located on the back of the garment. At the bottom of the huipil there is a white woven gauze-like strip that, according to the consultants, represents death.

Under the white segment at the bottom of the huipil, the colorful weaving begins once again indicating the cyclical nature of human existence.

The huipil is generally worn with a wool *rebozo* or blanket, a wrap-around skirt, a woven palm girdle, earrings, hair braids, beaded necklaces, and a tortilla basket. Sandoval Cruz (as quoted in Downs-Sánchez 2013:83) notes that the accessories that accompany the huipil are “essential cultural elements” and that the backstrap loom women use to weave their huipil is as important to the Chicahuaxtla Triqui people as is “agriculture, religion, the machete and the ax”.

The song describes the huipil along with all of its accoutrements: *sinĩ* [sinu:²] ‘skirt’, *stukuu* [ṣṣuku:23] ‘beaded necklace’, and *retoo* [reṭo:²³] ‘the *rebozo*’ or the ‘blanket’ that women use for keeping warm, carrying supplies or a small child. The song compares the color of Triqui women’s faces to that of a *sâna*, [sa⁴na:³] ‘apple’ and to a *pêre* [pe⁴re:³] ‘pear’, both derived from the Spanish words *manzana* ‘apple’ and *pera* ‘pear’, respectively. *Yanà hua ri’ni* [ʒana:¹ wa:³² ri⁴nu:³] is important not only because it is a tribute to the Triqui women but also because it emphasizes the valuable cultural symbolism that the huipil represents for the Triqui women and their community.

“Yanà hua ri’ni” is in 3/4 meter, and again uses the same predictable rhythm for each phrase. The melody is in D major and is built on arpeggios, which are broken triads. It centers on the D triad in measures 1–4, then alters it in measures 5–12, then centers on an A triad before landing on the final D note. The song consists of 8 lines that are also repeated four times in a sung performance. In the sung performance, each line consists of five syllables including those lines containing contiguous vowels that are sung as diphthongs rather than in hiatus as they may be pronounced in running speech (see Appendix B, Song #2, lines 5 and 6). Although this might be interpreted as a desire on the part of the native speaker to adapt his speech to the meter of the song, Elliott (2017) notes that the tendency for reducing vowels in hiatus to diphthongs is a commonly occurring phonetic feature in contemporary Chicahuaxtla Triqui speech, most likely due to the influence of Spanish. The song has an iambic rhythm, alternating between unstressed and stressed syllables or beats. Again, final syllables with a heavy tone load in Triqui may occur with or without a beat in the sung performance.

Like the first song, *Yanà hua ri’ni* consists of a series of *difrasismos*. The majority of lines in *Yanà hua ri’ni* are built around the fixed frame *Yanà hua* _____ ‘the woman has’. The focus element or constituent in each line is then filled by a different noun describing the types of objects women wear with the huipil. *Yanà hua* _____ ‘the woman has’ is replaced by *Yanà rian* _____ ‘the woman’s face’ in two lines of the song and compares the color of women’s faces to that of a *zâna* ‘apple’ or *pêre* ‘pear’. (For more information on poetic and lyrical analysis in Otomanguean and other Mesoamerican languages, see Cruz 2014; 2017).

Orthographic representations¹³ of the songs along with a broad and narrow transcription using the International Phonetic Alphabet (IPA) and a free translation are

¹³For more information on the conventional orthographic system of Chicahuaxtla Triqui, see Elliott (2017).

included in Appendix B. Tones are marked using superscripts and reflect the spoken performances of the songs.

6. Experiments

6.1 Experiment #1: Directionality Method Comparison study examining spoken tone transitions to note transitions in the musical scores. Different methods of analyses have been used in tone-tune directionality method studies, but the goal is essentially the same: to determine the degree of correspondence between note transitions in musical scores to tone transitions in spoken renditions of the song text. A transition is defined here as the pitch interval that occurs from one syllable to the next, in both speech and song (Proto 2016:163). The two methods of analysis covered here refer to what I call directionality comparison methods. In the first method, pitch transitions in sung and spoken performances of the song are coded for three possible directions of movement: 1) ascending, 2) descending, and 3) level. In the second method, transitions are coded as parallel, if the transition is the same in both sung and spoken performances; opposing, if the transitions between sung and spoken performances go in opposite directions (e.g., one goes up while the other goes down); and non-opposing, if the transition when speaking goes down but remains the same when singing (Schellenberg 2009, 2012a; Kirby, & Ladd 2016). For these studies, the relationship between note and tone transitions are tallied and the results are usually discussed based on the percentages.



In the first experiment, I opted to use the first method of analysis described above, adopting research methods used by List (1961), Richards (1972), Chan (1987), Agawu (1988), and Ketkaew & Pittayaporn (2014). For this portion of the study, linguistic tone and musical note transitions were examined across successive syllables and were coded as ascending, descending, or level. As previously stated, the term “musical notes” is used here to refer to the pitch of the sound and not as a measure of relative duration or rhythm. In addition to calculating percentages of agreement as has been done with many previous tone-tune studies, I also carry out a correlational analysis not only to determine the strength of the relationship between linguistic tone and note transitions, but also to ascertain to what degree the findings observed may be due to chance (i.e., p-values).

Figure 6 below shows a portion of the musical score for one of the songs and illustrates the coding method used in Experiment #1. Both musical note and tone transitions are written on two separate lines using the same coding system. The staff at the top shows the musical notes followed by an orthographic representation of the words and a narrow transcription below using the IPA. The bottom staff represents tones /¹/ through /⁵/ in Chicahuaxtla Triqui. The lines in the bottom staff are relative one to the other and do not represent specific F₀ values, pitches, tones, or musical notes. Lines connecting two dots in the bottom staff represent word-final tone contours, either ascending or descending. Although three-tone sequences occur in Chicahuaxtla Triqui, there are no words in either song ending in three-tone se-

quences nor are there words ending in tone /⁵/ which is always realized as a glide (e.g., /⁵³/ /³⁵/ /³⁵³/).

Musical note and tone transitions were coded as follows: ‘L’ represents a level note or tone transition in relation to the previous note or tone; ‘A’ identifies a note or tone that is higher in pitch relative to the previous note or tone; and ‘D’ signifies a musical note or lexical tone that descends in relation to that of the previous syllable. Given that the first note or tone of the song is not preceded by any other note or tone, it is included in the analysis as a reference note or tone that precedes either note or tone #2. For example, note #2 in the illustration below is marked as ‘L’, a level transition in comparison to the note of the previous syllable in the musical score while tone #2 in the speech performance is coded as ‘D’ because it is lower than that of tone #1.

Figure 6. Sample coding procedures used for assessing the interrelationship between musical note and tone transitions.

Note number:	1	2	3	4	5	6	7	8	9	10	11					
Coding:		L	A	A	D	D	A	D	A	D	D					
Musical score:																
Orthography:	Ya	-	nà	hwa	ri ¹	-	nī.	Ya	-	nà	hwa	si	-	nī.	Ya	-
IPA transcription:	[ʒa	-	na: ¹	wa: ¹²	ri ⁴ ?	-	nu: ³	ʒa	-	na: ¹	wa: ¹²	si ³	-	nu: ²	ʒa	-
Coding:			D	C	A	D	L	D	C	A	D	A				
Tone transitions:																
Tone transitions:																

Contour tones are noticeably absent from the musical scores of the two children’s songs used in this study. Although note #3 ascends in comparison to note #2 in the musical score, in the spoken performance of the song, tone #3 in the Chichahuaxtla Triqui word [wa:³²] ‘be’ or ‘has’ ends in a contour tone /³²/. Whenever there is a lexical contour tone in the speech performance of the song, as in tones #3 and #8 in the illustration, it was marked as ‘C’ (i.e., a contour tone) and was not included in the present analysis. Contour tones will be looked at separately.

Pearson correlations were calculated comparing level tone transitions with note transitions for both of the songs included in this study. Ascending tone transitions were coded as ‘3’, level transitions as ‘2’, and descending transitions as ‘1’. Analysis using SPSS showed that spoken tone transitions were not statistically significantly correlated with note transitions in the musical scores ($r = .16$, $p = .14$). Even when the songs were analyzed separately, the correlations remained non-significant, $r = .26$, $p = .07$ for “*Si-chra hian ‘anj an kij i’*” [si:³² t̪ʂa³ŋ jã³ŋã^{2h}ã kw^{3h}w] ‘The Sacred Goddess of the Mountain’ and $r = .14$, $p = .45$ for ‘*Yanà hwa ri’ni’*’ [ʒana:¹ wa:³² ri⁴nu:³] ‘The woman has her huipil’.

The present researcher was interested in seeing how individual level tones in the spoken performances were mapped onto the melody in the musical scores of the two

songs. Table 7 below lists percentages of tone transitions for the mapping of tones /¹/ through /⁴/ in Chicahuaxtla Triqui onto the musical scores. Chicahuaxtla Triqui extra low tones /¹/ were realized in their greater majority either as level or ascending transitions in relation to the previous note. Approximately 40% of words ending in tone /¹/ were mapped onto the songs as ascending note transitions while another 40% were level transitions in comparison to the previous note. Surprisingly, only 20% of the extra low tones in Chicahuaxtla Triqui were realized as descending transitions in the musical scores. Sixty percent (60%) of words ending in tone /²/ in the speech performance of the songs were mapped as descending note transitions while 40% were realized as level note transitions. None of the tone /²/ tokens were mapped as ascending transitions in the musical scores.

Table 7. Percentage of tone mapping onto the musical scores (n=87).

		MUSICAL SCORE			Total:
		Descending:	Level:	Ascending:	
Lex_tone	/1/	20%	40%	40%	11.9%
	/2/	60%	40%	0%	6%
	/3/	57.9%	19.3%	22.8%	67.9%
	/4/	0%	58.3%	41.7%	14.3%

Tone /³/ was mapped onto the musical scores 57.9% of the time as descending transitions, 19.3% were level transitions, and the remaining 22.8% were ascending. The majority of tone /⁴/ tokens, approximately 58.3%, were mapped onto the musical scores as level transitions, followed by 41.7% that were ascending. None of tone /⁴/ tokens were mapped as descending note transitions in musical scores of the songs.

As previously stated, contour tones, while present in the spoken performances, were absent from the musical scores. In order for contour tones to be mapped onto the melody of the musical scores, they would have had to have been mapped onto a single syllable that is sung with two contiguous notes, that is to say, melismatically. However, all contour tone sequences in the speech performances were reduced to one single note per syllable in the musical scores. In the speech performance of the songs, there were 25 contour tones, the majority of which (n=17; 15 falling and 2 rising) were in ‘The Sacred Goddess of the Mountain’. The remaining 8 contour tones in ‘*Yanà hua rini*’ [ʒana:¹ wa:³² ri⁴?nu:³] ‘The woman has her huipil’ were all falling. Table 8 lists percentages summarizing the overall tendencies evidenced in the mapping of contour tones onto the musical scores. For both songs combined, 92% of the contour tones in the speech performance of the songs were falling (e.g., /³²/) while the remaining 8% were rising, for example, /¹³/ and /²³/. The majority of the falling contours in the spoken performance of the song were expressed as level note transitions in the musical scores at a rate of approximately 48% while 32% were expressed as ascending note transitions. The remaining 12% of falling lexical contour tones equated with descending note transitions. All of the rising contour tone

sequences were realized as level note transitions rather than as ascending transitions, as one would expect if the notes in the musical scores mirrored tone transitions in the spoken performances.

Table 8. Mapping of contour tones onto the musical scores of the songs.

		Musical note transitions:			
		Descending:	Level:	Ascending:	Total:
Spoken contour tones	Falling contour:	12%	48%	32%	92%
	Rising contour:	0%	100%	0%	8%
	Contour totals:	12%	56%	32%	100%

The findings from the first experiment suggest that there is little evidence of a close correspondence between linguistic tone in relation to note transitions in the musical scores. In spite of the large number of tones and tone contours in Chichahuaxtla Triqui, the mapping of linguistic tone onto the musical scores was not statistically significant, thus invalidating the hypothesis that note transitions in the musical scores should mirror linguistic tone transitions provided that the songs are meant to be lexically meaningful.

6.2 Preface to Experiments #2 and #3 For the second and third experiments, all three versions of the songs (i.e., spoken, sung, and played) were segmented manually using the Textgrid feature in PRAAT. Figure 7 below shows sample pitch tracings for three different performances. The first set of tracings depicts the pitch trajectories for the *pizzicato* performance played on the guitar, while the second and third sets illustrate comparable pitch tracings for both the sung and spoken performances. As shown in the pitch tracings below, the played performance of the song is at a higher fundamental frequency in comparison to the sung and spoken performances.

F₀ measurements were taken from comparable portions of the three versions of the songs, including overall pitch range, average F₀, F₀ for individual tones, and the difference between adjacent tones as measured in Hz and semitones (with 0 set at 100 Hz). Measurements in semitones were not used in this study due to high levels of multicollinearity with the measurements in Hz ($r = .94 - .99$, $p < .0001$; $VIF = 4.034$).

Level tones were relatively easy to identify and segment, taking care that neighboring consonants (e.g., [n] [w]) did not color the pitch tracing of the tone. Contour tones were treated in this study as phonologically decomposable sequences of level tones and were segmented based on the observed movement in the F₀ noting the boundary between two successive level tones.¹⁴

Contour tones in the spoken performances of the songs were mapped onto the played performances as single notes. Single notes in the played versions were divided

¹⁴Although not all languages present evidence for the decomposition of tone contours into simpler units, for example, Austroasiatic and Tai-Kadai families (see Michaud 2008; 2017; Michaud & Vaissière 2015), Michaud (2008:14) notes that there is a wealth of evidence in support of analyzing contour tones as tonal sequences.

at their mid-point (50%) in order to extract two separate F_0 measurements and subsequently compare each measurement to that of the corresponding sequence of the contour tone values in both the spoken and sung performances. Segmenting tone contours in the spoken and sung performances, in addition to the separation of notes in the played performances permitted their inclusion in the statistical analyses below as opposed to leaving them out as described in Experiment #1 above. Figure 8 below provides an example of the method used for segmentation and analysis of contour tones for the Chichahuaxtla Triqui word *huq* [wa:³²] ‘be’ or ‘has’ in the spoken, sung, and played performances. Both average semitones and average Hz values are listed in the textgrid tiers below.

Figure 7. Pitch track comparisons between played, sung, and spoken performances of the songs.

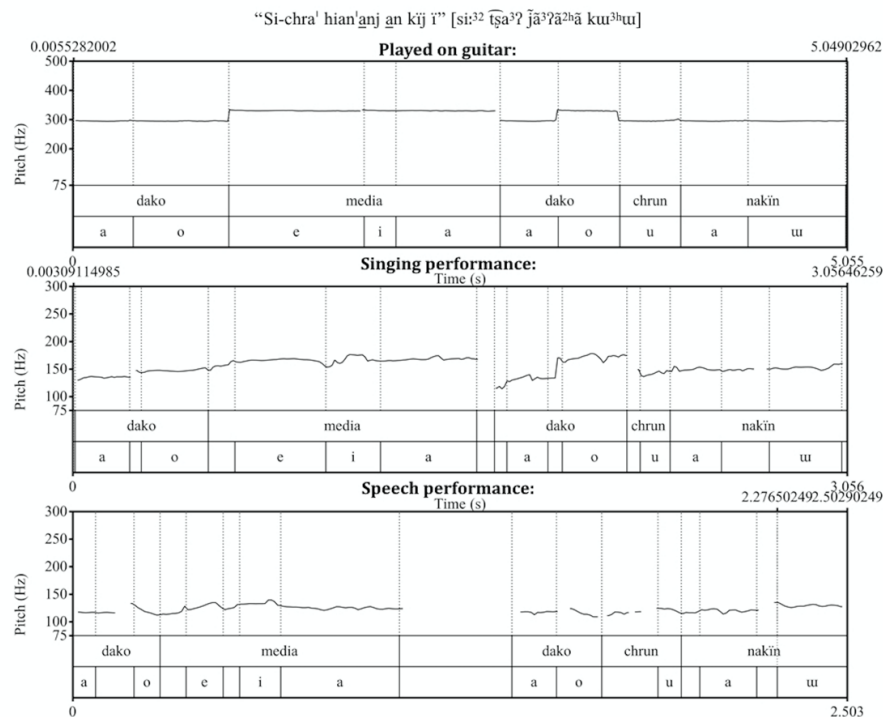
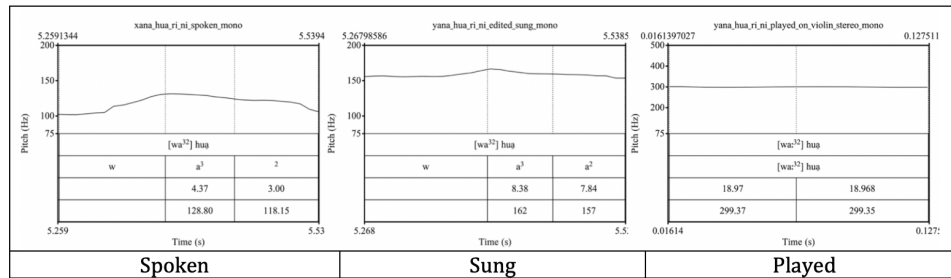


Table 9 below lists descriptive statistics for average pitch values in Hz for the spoken, sung, and played performances. A preliminary examination of the pitch values shows a greater pitch range for the consultant when he was singing (range 217.54 Hz – 104.05 Hz = 113.49 Hz) than in the spoken performances (range 165.41 Hz – 103.37 Hz = 62.04 Hz) of the song texts. The overall pitch range for the played performances was substantially larger at 332 Hz (range: 442.41 Hz – 110.14 Hz = 332.27 Hz). The played performances had an overall mean of 330.38 Hz compared to the sung performances with a mean of 164.80 Hz and the spoken performances at 129.45 Hz.

Figure 8. Spoken, sung, and played pitch tract comparisons for the Chichahuaxtla Triqui word [wa:³²] ‘be’ or ‘has’.

Mean Hz values for level tones /¹/ through /⁴/ in the spoken performances of the songs are as expected – lower mean values for low tones and higher mean values for high tones. While the means of tones /³/ and /²/ are very close, the range for tone /³/ is much greater at 49.02 Hz (SD = 9.63) in comparison to tone /²/ with a range of 15.21 Hz (SD = 7.708).

Table 9. Descriptive statistics for pitch values as measured in Hz for level tones /¹/ through /⁴/ in the spoken, sung, and played performances of the song texts.

Spoken performances:	Tone	Min	Max	Mean	SD	N	Range
	/1/	100.78	131.49	110.48	10.55	10	30.71
	/2/	120.28	135.38	128.61	7.708	3	15.21
	/3/	103.37	152.39	129.29	9.63	58	49.02
	/4/	128.68	165.41	149.43	10.35	12	36.73

Sung performances:	Tone	Min	Max	Mean	SD	N	Range
	/1/	105.93	217.54	162.09	31.44	10	111.61
	/2/	146.07	192.98	173.83	24.07	3	46.18
	/3/	104.05	217.54	153.24	27.11	58	113.49
	/4/	141.35	213.92	170.06	24.48	12	72.57

Played performances:	Tone	Min	Max	Mean	SD	N	Range
	/1/	291.19	439.36	357.31	59.21	10	148.16
	/2/	295.68	388.63	348.49	47.75	3	92.95
	/3/	110.14	437.22	293.97	68.67	58	327.08
	/4/	185.95	442.41	321.78	66.46	12	256.46

6.3 Experiment #2: The relationship between average Hz measurements in the spoken, played, and sung performances of the songs In the second experiment, I examine the strength of the relationship among average Hz measurements extracted from the pitch tracings for the spoken, sung, and played performances of the songs. The main question under investigation here is which of the independent variables, average Hz measurements for the played or spoken performances, best relates to and perhaps predicts variation in the average F_0 values in the sung performances.

Table 10 shows Pearson correlations comparing average Hz measurements for all three separate performances of the songs (i.e., spoken, played, and sung).

Table 10. Correlations comparing average Hz measurements for the spoken, played, and sung performances of the songs ($n = 132$)

	1	2	3
1 Average Hz Spoken Performance			
2 Average Hz Played Performance	.17*		
3 Average Hz Sung Performance	.27**	.50**	

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Average Hz measurements for the played performances showed the highest correlation with the equivalent measures for the sung performances, $r = .50$, $p < .01$. The correlation between the spoken performance and the sung performance was also statistically significant yielding an r -value of $r = .27$, $p < .01$. In addition, the spoken performance of the songs correlated significantly with the played performance ($r = .17$, $p < .05$).

Since the average Hz measurements of both the played and spoken performances of the songs were significantly related to the average Hz values for the pitch traces in the sung performance, a multiple regression analysis was carried out in order to determine whether or not both variables maintained their statistical significance when one of the independent variables is entered into the equation while holding the other constant. Tests for multicollinearity indicated a very low albeit acceptable level of multicollinearity ($VIF = 1.031$ for average Hz for the spoken performance, and $VIF = 1.081$ for average Hz for the played performance), thus indicating both variables may be used in the multiple regression analysis. Table 11 shows the results of this analysis.

The most significant predictor of the average of pitch traces in Hz for the sung performances of the song was the played performance ($t = 6.346$, $p < .05$). Average Hz measurements for the spoken performance of the song text were also significantly related to the sung performance ($t = 2.553$, $p < .05$). When the variable measuring average Hz for the played performance was entered into the multiple regression equation first, average Hz measurements of the pitch traces for the spoken performances remained significant in relation to the sung performances. The linear combination of the average F_0 measurements for the spoken and played performances were significantly related to the average F_0 measurements for the sung performances, $F(2, 129)$

Table 11. Multiple Regression Analysis using average Hz measurements for the spoken and played performances as predictors of average Hz measurements in the sung performances.

Dependent Variable	Step	Variable Entered	r ²	r ² Change	Beta	t
Average Hz Sung	1	Average Hz Spoken Performance	0.075	0.075	0.191	2.553*
	2	Average Hz Played Performance	0.294	0.219	0.475	6.346*
	1	Average Hz Played Performance	0.258	0.258	0.475	6.346*
	2	Average Hz Spoken Performance	0.294	0.035	0.191	2.553*

$p < .05$ ($n = 132$)

= 25.25, $p < .0001$. The multiple correlation coefficient was .53, indicating that approximately 28% of the variance of the average pitch measurements in the song performances can be accounted for by the linear combination of the average pitch measurements for both the spoken and the played performances of the songs.

One of the most significant findings is that neither of the independent variables, either the spoken or played performances of the songs, lost its power to predict the average Hz values for the sung performances. In other words, the average F_0 values of both the played and the spoken performances appear to contribute independently to the average Hz values of the pitch tracings in the sung performances of the songs. It would appear then that both the melody and linguistic tone play a role in the determination of pitch tracings of the sung performances, however, the pitch values of the played performance play a greater role as shown in the multiple regression analysis above.

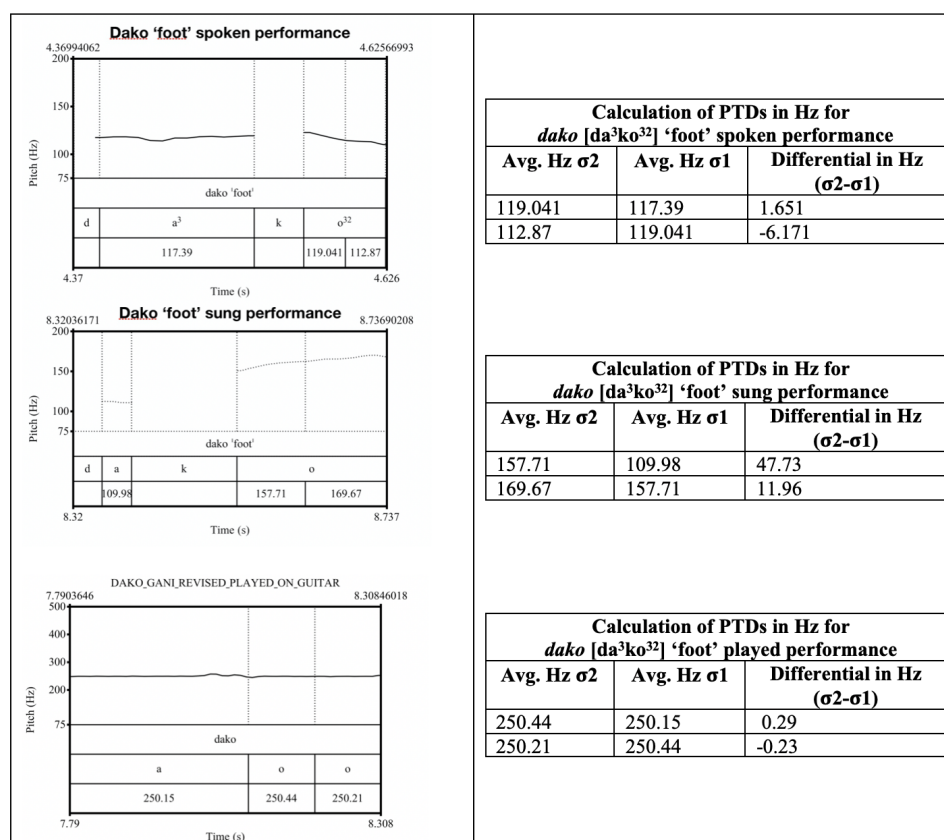
6.4 Experiment #3: The relationship between pitch transition differentials in the spoken, played, and sung performances

The main question under investigation in this portion of the study was which variable, either the average pitch transition differentials (PTDs) for the played and spoken performances of the songs, best relates to the average pitch transition differentials in the sung performances. For this portion of the study, average pitch transition differentials in Hz were calculated for all three performance types. Pitch transition differentials were calculated by subtracting the average Hz value of one syllable from the average Hz value of the previous syllable. Pitch transition differential coefficients measure the degree of change in the average F_0 values across successive syllables and are interpreted as follows: a) a positive differential value indicates an increase in the F_0 (i.e., a rise in pitch) while b) a negative value indicates a decrease in the F_0 (i.e., a lowering in pitch) across successive syllables.

Figure 9 below shows the method used for calculating average pitch transition differentials in Hz for all three performance types. In the spoken performance, the Chichahuaxtla Triqui word *dako* [da³ko:³²] ‘foot’ has an average pitch transition differential of 1.651 Hz from the first vowel in the first syllable to the first segment of the tone contour of the vowel in the final syllable. A positive value of 1.651 Hz indi-

cates a slight but acoustically imperceptible rise in the pitch value from the vowel in the first syllable to the first segment of the tone contour in the final syllable.¹⁵ Given that *dako* [da³ko:³²] ‘foot’ ends in a two-tone sequence (/³²/) in the spoken performance of the song, the second portion of the vowel has an average pitch transition differential of -6.571 Hz from the first segment of the tone contour to the last ($\sigma_2 - \sigma_1 = 112.87 - 119.034 = -6.571$). In the played performance, the average pitch transition differentials are minimal (e.g., 0.29 and -0.23 respectively) and are perceived acoustically as the same.

Figure 9. Sample calculation of pitch transition differentials (PTDs) for the spoken, sung, and played performances of the songs. (NOTE: The words presented here are not comparable tokens from the sung, spoken, and played performances. They are used here for expository purposes only.)



¹⁵ Although it is beyond the scope of this study, several investigations have focused on the *Just Noticeable Differences* (JNDs) in pitch perception. The JND measures the average degree of pitch change necessary in order for a difference to be acoustically noticeable or detectable to the listener. For more information on JNDs in speech perception, see Shower & Biddulph 1931; Bachem 1937; Rosenberg 1966; Johan 't Hart 1981.

As shown in Table 12, Pearson Product Moment Correlations were calculated to determine the strength of relationship among the pitch transition differentials for all three performance types. Pitch transition differentials for the sung performances were significantly correlated with the same measures for both the played performances ($r = .44, p < .01$) and the spoken performances ($r = .38, p < .01$) of the song text.

Table 12. Correlations comparing average pitch transition differentials in Hz among the played, sung, and spoken performances of the songs ($n = 132$).

	1	2	3
1 Average Played Differential (Hz)			
2 Average Sung Differential (Hz)	.44**		
3 Average Spoken Differential (Hz)	.23**	.38**	

** Correlation is significant at the 0.01 level (2-tailed).

A multiple regression analysis was carried out to determine which variable, either the played or spoken pitch transition differentials, most related to the variation in pitch transition differentials in the sung performances. Tests for multicollinearity indicated a very low but acceptable level of multicollinearity was present for the average pitch transition differentials for the spoken and played performances ($VIF = 1.17 - 1.24$).

Table 13 shows the results of the multiple regression analysis. The linear combination of average pitch transition differentials for the spoken and played performances were significantly related to the sung performances of the song texts, $F(2, 129) = 24.684, p < .0001$. The model yielded a multiple correlation coefficient of .53, indicating that approximately 28% of the variance of the average pitch transition differentials in the sung performances can be accounted for by the linear combination of both the average pitch transition differentials for the spoken and the played performances of the songs.

Table 13. Multiple Regression Analysis using pitch transition differentials for the spoken and played performances as predictors of pitch transition differentials in the sung performances.

Dependent Variable	Step	Variable Entered	r2	r2 Change	Beta	t
Average Hz Differential Sung	1	Hz Differential Spoken Performance	.14	.14	.297	3.85*
	2	Hz Differential Played Performance	.27	.13	.371	4.82*
	1	Hz Differential Played Performance	.19	.19	.371	4.82*
	2	Hz Differential Spoken Performance	.27	.08	.297	3.85*

$p < .05$ ($n = 132$)

Although both variables measuring average pitch transition differentials for the spoken and played performances were significantly related to the sung performances, the played performances in both models listed above were more significantly related

to the pitch transition differentials in the sung performances ($t = 4.82, p < .05$). This suggests that the melody of the played performances relates more to the sung performances than do the pitch transition differentials for the spoken renditions of the song text ($t = 3.85, p < .05$).

7. Discussion Conclusions from this research are restricted due to certain limitations in a study of this nature. The results and data presented here are from one speaker, singing two songs, from one particular genre. Although the findings in the second and third experiments suggest that the relationship between tone and tune is moderate in the children's songs based on the results of the multiple regression analyses, it is the present researcher's hope that this study serves as a step in the construction of a more comprehensive theory regarding the mapping of linguistic tone onto melodic tune in tone languages, especially with languages belonging to the Otomanguean family. Chicahuaxtla Triqui has a very complicated tone system, therefore, one would think that it would be necessary that melodic tune be highly intercorrelated with linguistic tone not only to communicate semantic meaning but grammatical information as well. This is especially true for those musical genres that are intended to be lexically meaningful. However, this may not always be the case. Consequently, the results and findings reported here cannot be considered ultimate answers on the tone-tune relationship but rather are intended to provide a cornerstone for ongoing and more detailed studies in the future.

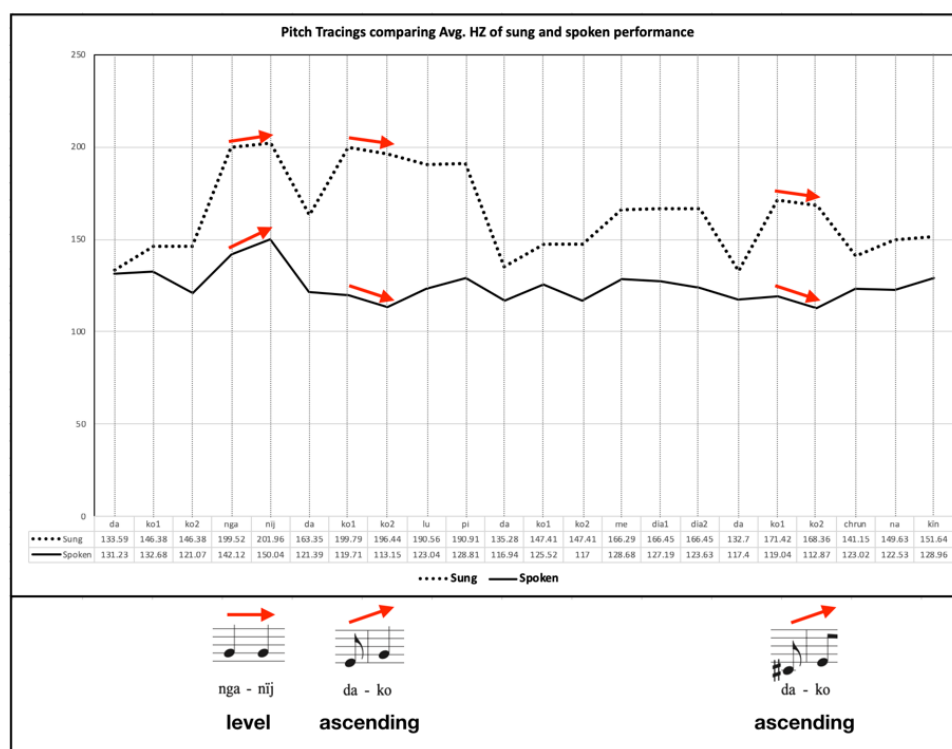
In this article I have outlined three separate procedures for looking at the relationship between tone and tune in spoken, sung, and played performances of two popular children's songs in Chicahuaxtla Triqui. Using some of the same methods used in previous tone-tune studies, the first experiment examined the strength of the relationship between tone transitions in the spoken performances of the songs in relation to note transitions in musical scores. Tone and musical notes were coded as ascending, descending, and level transitions, and in a correlational analysis the relationship between tone and note transitions was not statistically significant. A closer examination of the data revealed that level tones may be mapped onto the notes of the musical scores as ascending, descending, or level note transitions regardless of and unrelated to the directionality of pitch in the spoken performances of the songs. For example, if note transitions truly mirrored linguistic tone then lexical items ending in tone /¹/ should have been mapped onto the melody as descending note transitions rather than as level or ascending transitions.

In the first experiment, we saw that word-final contour tones were mapped onto the musical scores as single notes, (i.e., syllabically rather than melismatically). The finding that 32% of falling contour tones were realized as ascending note transitions and all of the rising contours were realized as level note transitions, is quite difficult, if not impossible, to reconcile linguistically. If linguistic tone in the spoken performances exercised a greater influence on note transitions in the musical scores, it is surprising that none of the rising contour tone segments were realized as ascending note transitions as an *a priori* hypothesis would predict.

Previous studies examining the directionality of linguistic tones in relation to that of musical notes have led some researchers to conclude that tone and tune are unrelated or, at best, are minimally related. As previously stated, the majority of these studies report percentages of agreement as measures of correspondence between tone and tune; however, these figures may also be problematic because the research literature has never explicitly stated what threshold is needed in order to say that the songs can be understood, assuming that the songs are meant to be lexically meaningful. Directionality comparison studies like these appear to operate under the assumption that note transitions in musical scores and tone transitions in spoken performances are from similar domains and can be reliably compared. A potential problem arises if the musical note transitions fail to capture significant movements in the Fo of the pitch tracings in the sung performance of the song, then the method of assessment will result in mismatches between tone and tune.

To illustrate this point, see Figure 10 below. Figure 10 lists pitch trajectories of the sung and spoken performances in the first four lines of *Dako nganij* compared to corresponding note transitions based on the assessment of the musical score. A visual inspection of the pitch tracings shows that both the sung and spoken performance have very similar pitch trajectories and do not appear to be due to chance.

Figure 10. Pitch tracings of average Hz measurements in the sung and spoken performances in the first four lines of *Dako nganij* compared to coding of corresponding note transitions in the musical score.



By comparing the coding method used for the musical note transitions to the actual pitch tracings, inherent weaknesses of the methodology used in the first experiment become apparent. For example, the word *nganĩj* [ŋganw⁴h] ‘shoe’, in Figure 10 above, was coded as having a level musical note transition suggesting that both syllables have the same fundamental frequency. However, a closer examination of the actual pitch tracings in the sung and spoken performances tells us something different. By observing the pitch tracings of both sung and spoken performances, the average Hz pitch values rise from the first syllable to the next, 2.44 Hz and 7.92 Hz in the sung and spoken performances, respectively. Based on pitch tracings of the sung performance, *nganĩj* [ŋganw⁴h] ‘shoe’ is ascending while according to its corresponding musical note transition, it is coded as level. In this case, the musical note transition does not capture the true fundamental frequency of this word. Likewise, both tokens of the Triqui word *dako* [dako:³²] ‘foot’ show a fall in the average fundamental frequency of the second syllable [-[ko:³²] in both the sung and spoken versions. The first instance of *dako* [dako:³²] ‘foot’ outlined in Figure 10 above has an average fall of -3.35 Hz in the sung version while the second drops an average of -3.06 Hz. Based on the musical note transition, however, the final syllable in *dako* [dako:³²] is coded as ascending while the pitch trajectories clearly show a fall. These discrepancies in coding between both pitch tracks and the musical note transitions should lead one to question the validity of directionality comparison studies as an acceptable method of tone-tune analysis and lends credence to Connell’s (2012:139) claim that simply matching up Hs and Ls is only scratching the surface and at best serves as a basic indication as to the influence linguistic tone might or might not have on melodic tune. The implication is that there is an underlying melody in the sung renditions that is not adequately represented by the musical notation. Similar findings were reported by Morey (2010; 2014), Lissour & Demolin (2015), Proto (2016), Morton (1976) and Tanese-Ito (1988).

What I am not able to answer here is whether or not the contour tones in the sung version are maintained when the consultant sings along with musical accompaniment since all three performance types of the songs were recorded separately. It would be interesting to determine whether or not the singer maintains tone contours when singing with the music. Previous research seems to suggest that there is an instrumental melody that is related to but at the same time independent from the pitch tracings of both the spoken and vocal renditions. Research by Tanese-Ito supports this assumption. Tanese-Ito (1988:112) states that “unaccompanied singing may stem from the need for the text to be intelligible, and also from the use of ‘vocal tones’ (Morton 1974) that do not correspond to the fixed pitches of the instruments”. She adds that whether the song is sung or played “the vocal melody may differ somewhat from the instrumental melody. Each is superimposed on the same abstract, basic, melodic line, though usually composed separately”. Tanese-Ito (1988:112) adds that while the “instrumental and vocal versions of a melody share the same structurally important pitches [...] [the] vocal versions make use of their own melodic formulas”, probably due to the exigencies of linguistic tone. The data presented in Figure 10 above support Tanese-Ito’s assertions. In order to determine whether there is an un-

derlying vocal melody that is separate from the instrumental melody, in a future study, the consultant could listen to the musical accompaniment using one ear through headphones while the other ear is uncovered so he can hear his own voice while singing. This would allow one to record the subject singing the song with musical accompaniment without recording the actual musical performance. The results may show that contour tones are maintained even when singing with the musical accompaniment in spite of the fact that in the musical notation, such contours are frequently represented by only one note (i.e., one pitch).

While the correspondence between note and tone transitions in the first experiment was non-significant, we found that using a well-defined set of prosodic features such as overall pitch range, average F_0 , F_0 for individual tones, and the differences in Hz across adjacent tones appears to be more promising and should be considered when comparing the correspondence between tone and tune.

In the second experiment, average F_0 measurements for all three performance types were significantly interrelated in a correlational analysis. In a multiple regression analysis, both the played and spoken performances related to the variation in the average F_0 measurements in the sung performances of the song texts. However, average F_0 measurements of the played performances related to the pitch tracings in the sung performances more than the same measurements for the spoken performances of the songs. The implication here is that melody plays a more significant role in the determination of the pitch tracings in the sung performances than does linguistic tone.

Likewise, the findings in the third experiment support those reported in Experiment #2. In a correlational analysis, pitch transition differentials in the played and spoken performances of the songs were significantly related to comparable measures of the sung performances. Again, a multiple regression analysis showed that the average pitch differentials for the played performances were more significantly related to the sung performances in comparison to the same measurements for the spoken renditions of the song texts. While both regression models reported here accounted for approximately 28% of the variance in the average F_0 measurements and pitch transition differentials in the sung performances of the songs, 72% of the variance in the pitch tracings of the sung performances is yet to be explained.

8. Future research and implications for Documentary Linguistics and Indigenous language communities

Future research should examine a larger corpus of children's music in Chicahuaxtla Triqui. Unfortunately, the total number of children's songs is limited. Sandoval Cruz reports that the elementary school children learn approximately nine songs in Chicahuaxtla Triqui. Four of which are unquestionably of Triqui origin – the two songs included in this study plus two others titled “*Yato*” [ʒaʔo:³] ‘Bunny Rabbit’ and “*Natan*” [naʔã:³] ‘String Beans’. The remaining songs are adaptations from Spanish that were translated into Chicahuaxtla Triqui, for example, *El tequio* ‘Community-wide service labor’, *Flor de canela* ‘Cinnamon Flower’, and *El gal-lito* ‘The little chicken’. Previous tone-tune research has shown, however, that songs that are translated or adopted from other languages are precisely those that have

the greatest number of mismatches between linguistic tone and melodic tune (Chan 1987; Saurman 1999). Therefore, borrowed songs do not appear to be promising in the area of tone-tune analysis.

Additional studies should focus on different musical genres such as contemporary adult music, chanting, recitations, and religious hymns, to name a few. Future research may eventually reveal that linguistic tone is followed more consistently depending upon the genre, especially for song genres targeting adults as opposed to children. Mang (2007:61) found that “young Chinese children tend not to exhibit similar rejection over tone-mismatched songs as adults” typically do. This finding may also apply to Chicahuaxtla Triqui, however, more research is needed to support such a claim. The ideal corpus would consist of songs that are incontrovertibly Triqui in origin. Care must be taken when analyzing songs that include loanwords from languages as these have been shown to have an influence on tonal melody of native indigenous words (Pike 1939), however, in what ways still remains to be answered.

Turpin & Henderson (2015:89–90) state that field linguists frequently find themselves recording songs because many language communities ask them to do so and argue that linguists “are not always equipped with the knowledge and skill to analyze verse and draw out its significance for language”. Linguists who are interested in documenting and analyzing songs may find themselves in the position of having to retool, learn new skills, and master new content domains. For example, in order to carry out tone-tune analyses, the field linguist will have to know music theory such as the elements of notation, key and time signatures, rhythmic notation, and musical scales. Not only must one be well versed in the rudiments of music, one must also have an understanding about poetic analysis including rhyme schemes, meter, and rhythmic patterns in order to determine whether or not these are relevant to the analysis. These issues, in themselves, may lead some documentarians to question whether or not the documentation of music is a worthwhile effort on the part of the linguist? I believe the answer is ‘yes’ and will outline some of the benefits below.

Turpin & Henderson (2015:92) argue that songs may reveal things about vocabulary and meaning that might not surface otherwise in everyday speech or through elicitation alone, for example, emotional words, such as terms of endearment, or vocabulary with very highly specialized meanings relating to dance styles, animal behaviors, as well as culturally-specific items and practices. For example, Barwick et al. state that while documenting Iwaidja *Jurtbirrk* love songs, “new domains of emotional vocabulary emerged and the songs’ frequent use of first and second persons and directionals filled in some missing slots in the Iwaidja verb paradigms that had proven next to impossible to elicit directly” (Barwick 2012:171).

In addition, Barwick (2012:172) notes that “working on song and music can be a great way to build relationships with collaborators and produce tangible outputs” such as compact discs, video performances, or small picture books as remembrances of the occasion that can be given back to the language community. For example, the first time we visited the elementary school in Miguel Hidalgo Chicahuaxtla, we recorded and videotaped the children singing “The Sacred Goddess of the Mountain”. Using the school supplies we gave them, we asked the children to draw pictures de-

picting the Sacred Goddess and other elements of the song they just sang to us. The children were then asked to write up a small paragraph describing themselves in Chicahuaxtla Triqui with help from their teacher and parents, who were also present that day. Upon return from the village, my graduate and undergraduate students, who were also carrying out fieldwork on Chicahuaxtla Triqui, translated the children's paragraphs to Spanish and English and used iBook Author¹⁶ to create a small printed book that included the children's drawings, their pictures, and short biographies in all three languages. The following year we took 25 printed copies of the book to the village to give to the lead teacher who uses them to help teach the children to read Chicahuaxtla Triqui, Spanish, and English. This exercise was beneficial because it not only gave us more insight into the Chicahuaxtla Triqui language but it also taught us a very important cultural legend that we might not have found out about otherwise had we used only traditional elicitation methods.

Music and the documentation of songs is not only valuable to the linguist but also to the children and the community as well. Sandoval Cruz, the lead teacher of the elementary school in Miguel Hidalgo Chicahuaxtla and the children's music teacher, states that there is a tangible benefit that can be observed in the children from learning to sing in Chicahuaxtla Triqui. He (personal communication, 2017) notes "los niños se vuelven más seguros de sí mismos y ganan al aprender a concentrarse en la ejecución de la música, lo cual no permite distracción y requiere dedicación y ensayo para poder tocar y cantar bien".¹⁷ In addition, singing in Chicahuaxtla Triqui serves as a vehicle for language development and helps students learn how to read, write, and speak the language. This is especially crucial for some children whose only access to the language is in school, through their lessons and through the music they learn. Sandoval Cruz (personal communication, 2017) argues that learning about music and being able to sing in Chicahuaxtla Triqui provides the children with greater insight into music and, by extension, how musical notes relate to linguistic pitch and tones. He states:

Al aprender música, uno desarrolla su 'oído musical' que es la capacidad de reconocer diferentes tipos de sonidos y tonalidades y por supuesto, ese 'oído musical' nos ayudará a aprender las lenguas tonales, especialmente el triqui (personal communication, 2017).¹⁸

Sandoval Cruz (personal communication, 2017) states that teaching the children to sing in Chicahuaxtla Triqui not only furthers the community's efforts for language conservation and maintenance, it also gives students a greater sense of pride in their heritage, culture, and language by being invited to give public performances. For example, Sandoval Cruz tells how the children were invited to sing at a Lila Down's

¹⁶A complete copy of the book can be viewed at <http://en.calameo.com/read/Elliott>.

¹⁷"[...] the children become more confident in themselves and benefit from learning to play music, which doesn't allow for distraction and requires dedication and practice in order to play and sing well."

¹⁸"When learning music, one develops an ear for music which is the ability to recognize different types of sounds and tones, and of course, this 'musical ear' helps us to learn tonal languages, especially Triqui."

concert in *La Guelaguetza*¹⁹ in Oaxaca, Mexico in front of an audience of more than 10,000 people. He summarizes the experience as follows:²⁰

Fue una experiencia inolvidable. Teníamos miedo de que la gente (más de 10 mil) no nos recibiera bien pero por fortuna la reacción del público fue muy buena. Aplaudieron bastante y los niños fueron muy felicitados. Y [...] eso ha sido muy bueno para ellos, sobretodo porque cantamos dos canciones únicamente en triqui y tuvo buen recibimiento. El aprecio social es muy importante para querer seguir siendo y hablando el triqui y eso es fundamental.²¹

Recently there has been a renewed interest in the verbal arts as a means of documenting a wide array of linguistic practices and language use within a community. Fitzgerald (2017:114) states that verbal arts is an umbrella term that includes “poetry, song, nursery rhymes, lullabies, puns, storytelling, tongue twisters and wordplay”. The decision to document songs is ultimately one that each linguist will have to make at one time or another when doing fieldwork. The present researcher believes that the documentation of songs is useful for reasons that go well beyond linguistic theory and the analysis of tone by providing the linguist with additional insights into cultural practices and knowledge systems, especially for those languages that may be highly endangered (Feld 2012; Turpin & Henderson 2015). Barwick (2012:171) argues that “documenting musical events when they occur (and when invited) falls squarely into language documentation’s brief to be diverse and representative of as wide a range of language use as possible”. Woodbury (2003) urges language documenters to “take advantage of any opportunity to record, videotape, or otherwise document instances of language use” and this would certainly entail the documentation of music. In order to have as complete a language description as possible, songs have to be included (Turpin & Stebbins 2010; Barwick 2012; Turpin & Henderson 2015). Drawing upon my own personal experiences with the Chicahuaxtla Triqui children and their community, documenting songs and learning to sing in Chicahuaxtla Triqui has not only given me and my students greater insight into their culture, their legends, and language, it has also helped to take our relationship with the Triqui people to another level – one that goes beyond our roles as documentarians or linguists. Music is the universal uniter – it’s something we all have in common; it’s something that we all

¹⁹The Guelaguetza is an annual event that takes place in Oaxaca usually on the last two Mondays in the month of July. Members from many indigenous communities throughout Oaxaca come to celebrate their indigenous roots by donning their traditional clothing and performing music and dances that are representative of their communities. The festival is also referred to as “Los lunes de los cerros” or ‘Mondays in the Hills’. For more information on La Guelaguetza, see Guelaguetza-Oaxaca (<http://www.viveoaxaca.org/p/guelaguetza2017.html>).

²⁰The children’s performance at the Lila Down’s concert at *La Guelaguetza* can be seen at Triqui Children Performance-La Guelaguetza (<https://www.youtube.com/watch?v=7zUHIBiDi4s>). The songs that were performed are the same that were included in this research.

²¹“It was an unforgettable experience. We were afraid that the people there, which were more than 10 thousand, would not receive us very well, but fortunately, the public’s reaction was very good. They applauded a lot and the children were congratulated. And [...] that was very good for them, above all because we sang two songs that are uniquely Triqui and it was well received. It’s very important to get social recognition in order to continue being Triqui and speaking Triqui and that’s fundamental.”

enjoy and it brings us pleasure. By failing to document songs, the field linguist may be forfeiting a perfect opportunity to have a direct window into a particular community – a prospect to appreciate a particular culture’s values, their historical figures, artifacts, myths, legends, and even taboos.

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Appendix A.

Si-chra' hian'anj an kij i (Dako nganij)

Anonymous

Da - ko nga - nij da - ko lu - pi, da - ko me - dia, da - ko chrun na - kin, da -

5 ko nga - nij, da - ko lu - pi, da - ko nga - nij, da - ko lu - pi. Si

9 gan' re' - è a - hui la - tsin, rian la - di' - in, a - hui hui' - i. Da

13 ko nga - nij, da - ko lu - pi da - ko nga - nij, da - ko lu - pi.

Yanà huà rì' nǐ

Anonymous

Ya - nà huà rì' - nǐ. Ya - nà huà si - nǐ. Ya -

5 nà huà stu - ku. Ya - nà huà re - tò. Ya -

9 nà rian sà - na. Ya - nà rian pē - re. Ya -

13 nà huà rì' - nǐ. Ya - nà huà si - nǐ.

Appendix B.

SONG #1. ‘The Sacred Goddess of the Mountain’

TITLE: *Si-chra biananj an kij i*
 si:³²-tʂa³? jã³?ã²hã kw³hw
 si:³²-tʂa³? jã³?ã²hã kw³hw
 POSS:song god mountain
 ‘Song of the mountain goddess’

(1) *Dako nganj*
 dako³ nganw⁴h
 ɖako:³² ŋganw⁴h
 foot shoe
 ‘Foot with a shoe’

(2) *Dako lupi*
 dako³ lupi³
 ɖako:³² lupi:³
 ‘Foot like a turkey’

(3) *Dako mēdia*
 dako³ media³²
 ɖako:³² meɖia:³²
 ‘Foot that uses socks’

(4) *Dako chrun nakin*
 dako³ tʂũ³ nakũ³
 ɖako:³² tʂũ:³ nakũ:³
 ‘Foot like a madroño tree’

(5) *Dako nganj*
 dako³ nganw⁴h
 ɖako:³² ŋganw⁴h
 foot shoe
 ‘Foot with a shoe’

- (6) *Dako lupi*
 dako³ lupi³
 ɖako:³² lupi:³
 ‘Foot like a turkey’
- (7) *Dako nganîj*
 dako³ nganw⁴h
 ɖako:³² ŋganw⁴h
 foot shoe
 ‘Foot with a shoe’
- (8) *Dako lupi*
 dako³ lupi³
 ɖako:³² lupi:³
 ‘Foot like a turkey’
- (9) *Sî-gan' re'è*
 si:³² gā^{32?} reʔe¹³
 si:³² gā^{32?} reʔe:¹³
 POSS:clothes worn-out
 ‘Worn out and dirty clothes’
- (10) *Ahui latsin*
 awi³ latsi³
 awi³ laʔsi:³
 hair disheveled
 ‘Disheveled hair’
- (11) *Rian ladiʔin*
 riā³² laduʔũ⁴
 riā:³² laɖuʔũ:⁴
 face dirty
 ‘Dirty face’
- (12) *Ahui hui'i*
 awi³ wiʔi³
 awi³ wiʔi:³
 hair blonde
 ‘Blonde hair’

(13) *Dako nganiĵ*
 dako³ nganw⁴h
 ɖako:³² ŋganw⁴h
 foot shoe
 ‘Foot with a shoe’

(14) *Dako lupi*
 dako³ lupi³
 ɖako:³² lupi:³
 ‘Foot like a turkey’

(15) *Dako nganiĵ*
 dako³ nganw⁴h
 ɖako:³² ŋganw⁴h
 foot shoe
 ‘Foot with a shoe’

(16) *Dako lupi*
 dako³ lupi³
 ɖako:³² lupi:³
 ‘Foot like a turkey’

SONG #2: 'The Woman has her huipil.'

TITLE: *Yanà hua rî'ni*
 ʒana¹ wa³² ri⁴ŋw³
 ʒana:¹ wa:³² ri⁴ŋw:³
 woman has huipil+T₃ is possessed
 'Woman with a huipil'

(1) *Yanà hua rî'ni*
 ʒana¹ wa³² ri⁴ŋw³
 ʒana:¹ wa:³² ri⁴ŋw:³
 woman has huipil+T₃ is possessed
 'Woman with a huipil'

(2) *Yanà hua sinî*
 ʒana¹ wa³² sinw²
 ʒana:¹ wa:³² sinw:²
 woman has skirt
 'Woman with a skirt'

(3) *Yanà hua stuku*
 ʒana¹ wa³² stuku²³
 ʒana:¹ wa:³² s̩tuku:²
 woman has necklace
 'Woman with a necklace'

(4) *Yanà hua reto*
 ʒana¹ wa³² reto¹³
 ʒana:¹ wa:³² reto:¹³
 woman has blanket
 'Woman with a blanket'


(5) *Yanà rian sâna*
 ʒana¹ riã³² sana³
 ʒana:¹ riã:³² sa⁴na:³
 woman face apple
 'Woman with a face like an apple'

- (6) *Yanà riān pêre*
 ʒana¹ riā³² pere³
 ʒana:¹ riā:³² pe⁴re:³
 woman has pear
 'Woman with a face like a pear'

- (7) *Yanà huā ri'ni*
 ʒana¹ wa³² ri⁴niw³
 ʒana:¹ wa:³² ri⁴niw:³
 woman has huipil
 'Woman with a huipil'

- (8) *Yanà huā sinī*
 ʒana¹ wa³² sinw²
 ʒana:¹ wa:³² sinw:²
 woman has skirt
 'Woman with a skirt'

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